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AND

IMPAIRED VISION,

WITH THE

CLINICAL USE OF THE OPHTHALMOSCOPE

IN THEIR

DIAGNOSIS AND TREATMENT.

By LAURENCE TURNBULL, M.D.,

OPHTHALMIC SURGEON TO HOWARD HOSPITAL; MEMBER OF THE AMERICAN MEDICAL ASSOCIATION, ETC.

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PHILADELPHIA:

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PREFACE.

In June, 1859, was published by the author, an account of the "Clinical Use of the Ophthalmoscope in Diseases of the Eye," in the Medical and Surgical Reporter of this city; this was reprinted and distributed among his friends privately, and since that time much that is new and interesting on the Ophthalmoscope and Deep-seated Diseases of the Eye has been published in Europe and in this country, but no one thought it worth his time and trouble to bring it in a condensed form before the great mass of intelligent and reading physicians of the United States. Having again found it my duty to publish a series of articles in a weekly medical journal on this subject, my friends have considered them worthy of publication in this form, indeed a distinguished Ophthalmologist* of a sister city writes me as follows: "With a great deal of interest and satisfaction I have seen your articles on the Ophthalmoscope, &c., in the Philadelphia Reporter." This will therefore be my apology for reprinting this little work on the Ophthalmoscope.

THE AUTHOR.

1208 *Spruce Street, Philadelphia*, 1864.

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* Dr. J. Homberger, Editor American Journal Ophthalmology, New York.

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DEFECTIVE AND IMPAIRED VISION,

WITH THE

CLINICAL USE OF THE OPHTHALMOSCOPE.

My attention has recently been directed to the subject of defective and impaired vision, having been appointed an examining surgeon by the Governor to examine men who were drafted and who desired exemption. The proportion of cases of short sight, or myopia, was fifty in the thousand, while the cases of weak sight or Amblyopia, cataract, amaurosis, astigmatismus, granular disease, &c., was only twenty-five in one thousand cases. I have therefore come to the conclusion that as the fifty cases of myopia had been so since boyhood or girlhood, and in a few of the instances only was the defect hereditary, there was a neglect on the part of parent or guardian in not preventing so bad a habit. There is also a good deal of the blame to be attached to the family physician, who, when his attention is called to the weak eyes of the near-sighted child, neglects to place it on a proper course of treatment so as to improve the general health and eyes at the same time.

I therefore thought some practical observations upon this and kindred subject, in a series of articles, would be acceptable to the members of the profession whose attention is perhaps only called to a case once in six months or a year, and who have not the opportunities which our city physicians have of calling in consultation one of their brethren who devotes much of his time and talents to this one subject, and who is posted on all the improvements which the last ten years has produced.

The Ophthalmoscope.

And first of the ophthalmoscope or speculum oculi, for without the use of this important aid in diagnosis we will often make most serious mistakes. Its employment requires a little more ingenuity and about the same amount of time and attention which is necessary to become expert with the stethoscope; and certainly no right-minded and conscientious physician should be satisfied in deciding upon the existence of amaurosis in any case without a prior examination with the ophthalmoscope. With just as much certainty could we consider a patient to be laboring under phthisis, without a physical examination, because he has purulent expectoration and fever. It will also be found that there are numerous cases of defective and diseased eyes, which formerly would have been pronounced hopeless, but which upon a careful examination by this admirable invention of Helmholtz's, are ascertained to be curable, and the reverse will equally hold good, thus preventing a long and tedious course of treatment, often to the detriment of the patient's general health and our own discomfiture. Those who use the ophthalmoscope claim for it that it enables them to decide promptly and almost with certainty as to the seat of the disease and its nature, if situated in the crystalline lens, its capsule, the vitreous humor, the retina, choroid, and even the entrance of the optic nerve.

But as is usually the case with every innovation upon old ideas, there is always found a certain number who stand opposed to its employment, and, as would naturally be anticipated, it comes from the same class of men who opposed the introduction of vaccination, anæsthesia, and other equally valuable adjuncts to our profession, and

who are equally well represented outside of our profession by the opponents to the introduction of steam, gas, the electric telegraph, &c. Being unwilling to learn its use by the sacrifice of time and labor, they endeavor to produce its condemnation by a variety of objections, among which may be mentioned the charge that it has injured the eye by the bright light which has to be employed in the examination, or that danger may result from the use of the solution of atropia. These, I am confident, have but slight existence, as in the numerous examinations which I have made with the valuable instrument both in hospital and private practice, since May, 1853, it has rarely been my lot to hear a complaint from my patients, or to see any injurious consequences result from its use. When in London, in 1859, on a visit to the Royal Ophthalmic Hospital, Moorfield, I made the inquiry of Dr. DIXON, one of the surgeons, if he had ever seen any injurious results follow the use of the ophthalmoscope, when he stated that only in one case in thousands had he remarked any detrimental results, and in this case was a lady who subsequently died of apoplexy. He noticed that after such examination there was an increased effusion of blood upon the retina. This single instance of injury would be but a poor excuse for our rejection of so valuable an aid to diagnosis, which, according to H. HAYNES WALTON, has revolutionized ophthalmic nosology, and rendered obsolete nearly everything that has been written or taught on the deep-seated diseases of the eye.*

It was well observed by WILLIAM BOWMAN, the distinguished physiologist and surgeon of the London Ophthalmic Hospital, "We have fallen on a time that will be forever memorable in the history of ophthalmic science—the epoch of the invention (and application) of the ophthalmoscope."

"What would be thought by physicians if they were presented with an instrument enabling them to *see* the membranes, the cavities, the course of the fibres, the configuration of the ganglionic masses of the *brain*, with the vessels pulsating, the veins varying in emptiness or repletion, and every product and physical condition of disease exposed to view? Or if the great organs of the chest or belly, with all their complicated connections and movements in a healthy or unhealthy state, were disclosed? They would be transported with delight at the facilities given for the exact detection of disease; and doubtless a harvest of great results would instantly be reaped in the field of practical medicine. What I have imagined for the great cavities of the body, came to pass for the delicate structures of the eye about eleven years ago. We may be all *clairvoyants* now for this hollow organ, into which we can penetrate by the aid of the reflector, and discern (in all where the media remain transparent) the physical conditions of the internal coats, with the exquisite course and aspect of the vessels, and the faintest morbid alterations of structure, as clearly and brilliantly as if they were opened up by the anatomist, or placed under a lens on the table before us. And where the media are themselves faulty, the faults can be detected in their earliest and slightest forms by the same means. So long as there are human eyes to suffer damage from disease, or cultivators of the divine art of healing, so long will the ophthalmoscope be in universal use, and the name of HELMHOLTZ be held in honor among mankind. No less than a total revolution in ophthalmic practice has been already effected by this instrument, and constant further advances may be confidently anticipated in our knowledge, not only of the disease of the eye itself, but collaterally of various cognate affections of other organs, especially of the brain."*

Diagnosis is the all-important secret of the physician, without which our therapeutics are but an agency of evil, destroying what we wish to cure, and from this consideration alone every physician and surgeon should gladly avail himself of all the auxiliaries within his reach.

In 1846, Cumming†, of London, first determined that by a certain arrangement of a gas light and a lens the fundus of the human eye could be seen. He did not see the optic nerve nor the retinal vessels. "His simple process of examination was this: Let the person under examination (with the dilated pupil) sit or stand eight or ten feet from a gas light looking a little to the side; standing near the gas light we have only to approach as near as possible to the direct line between it and the eye to be viewed, at once to see the reflection. Or in a dark room, a candle being placed four or five feet from the eye, if we approach the direct line between them we shall be able at once to see it in many cases. If solar light be admitted through a newly closed shutter into a dark room the luminosity may be seen when the pupil is tolerably dilated, the patient standing five or six feet from the aperture and the observer occupying the position before indicated." "In persons of fair complexion and blue or gray irides, it is generally

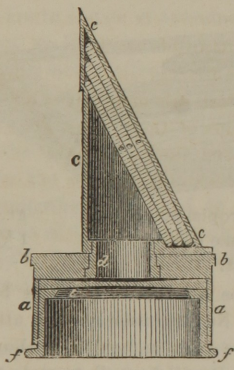
* A treatise on the Surgical Diseases of the Eye, p. 654, econd edition, London, 1861.

* American Journal of Ophthalmogy, Vol. 1, No. 3, pp. 104, 105.

† Medico-Chirurgical Transactions, 1846.

more brilliant and more readily seen than in those of dark skin and irides. In the mulatto it is also dusky."

To Dr. MACKENZIE is due a part of the credit of applying the first rudimentary ophthalmoscope to the investigation of deep-seated diseases of the eye. His method consisted in directing the light of a gas jet through the dilated pupil with a lens, so as to discover "what he considered the effects of hyaloiditis, or inflammation of the hyaloid membrane."* But the credit of the invention is due to Helmholtz, professor of Physiology at Konigsburg, Prussia, who made and described the first ophthalmoscope, and published it to the world in 1851.† He first employed a single slip of glass brightly polished, and with this he was able to see the surface of the retina but very faintly, not dilating the pupil in his first examinations. Finding that the illuminating power of a single slip of polished glass was too faint to view the minute details of the fundus, Helmholtz increased its intensity by constructing a compound reflector of several slips, superimposed in such a manner that the reflections from their several surfaces cover each other, and coalesce in a single image. For greater convenience he fixed this reflector upon one end of a short tube, in the opposite extremity of which he placed a concave lens. In Fig. 1 is a



horizontal sectional view of HELMHOLTZ'S instrument. Fig. 1, *aa* is a short blackened metal tube closed at one end by a plate *bb*, centrally perforated, which supports a hollow triangular prismatic metal box *ccc*. The base of this prism is connected with the plate by the short open cylinder *d*, in such a manner as to allow the rotation of the prism on the axis of the tube *aa*. The long side of the prism contains the reflector, composed of three plane polished slips of glass, inclined at an angle of 56° to the axis of the tube, the other end of which contains the concave lens *l*, which is held in position by the friction tube *f*. When we examine the healthy eye of a young person the pupil appears dark, as if the bottom of the eye was black. This is not because any of the tissues are black that we look through, but it arises from the refractive power of the cornea and lens. HELMHOLTZ, by overcoming the refraction of the cornea and lens by his ophthalmoscope, reflected the rays of light from the retina and made them come to a focus and produce an image on the retina of the experimenter's eye. It is stated that an accident suggested the invention to HELMHOLTZ, but this is doubtful, as "Cummings'" experiments were published and sent all over the world, still we give it as stated. His friend VON ERLACH, who wore spectacles, observed one day whilst conversing with an acquaintance, that the eye of the latter became illuminated when the rays of the light from a neighboring window were reflected by his glasses into this person's eye—hence it is also stated the probable reason of HELMHOLTZ using plate glass as the reflector in his ophthalmoscope. There is no doubt that the immortal honor of the invention of the eye speculum, or ophthalmoscope, belongs to HELMHOLTZ, although many others may have contributed to it, he made it truly practical, and with it he was able to distinguish the optic nerve and the vessels emerging from it. In 1852, RUETE* invented an ophthalmoscope on a different principle from that of HELMHOLTZ, light being thrown into the patient's eye by means of a concave mirror, through a hole in the centre of which the observer looked directly upon the illuminated retina. The objection to this ophthalmoscope is, that it is fixed upon a stand and therefore not well adapted to observe an organ so constantly in motion as the eye. COCCIUS† avoided this inconvenience by constructing a small perforated mirror to be held in the hand, and this instrument has been still further modified by ANAGNOSTAKIS,‡ whose ophthalmoscope, from its extreme simplicity, appears to many to be the most useful that has been invented. It consists of a circular mirror, about an inch and three quarters in diameter, slightly concave, and perforated in the centre with a round hole, the tenth of an inch wide. The amalgam of the mirror is protected by a brass plate perforated at a spot corresponding to

* Mackenzie on Diseases of the Eye, p. 564. Am. Ed.

† Beschreibung eines Augenspiegels zur Untersuchung der Netzhaut im lebenden Auge, Berlin, 1851.

* Der Augenspiegel und das Optometer, Gottingen.

† Ueber die Anwendung des Augenspiegels, Leipzig, 1853.

‡ Essai sur l'Exploration de la Retine et des Milieux de l'Œil sur la Vivant, Paris, 1854.

the hole in the glass. The inside of this perforation should be brushed over with a non-reflecting black coating so as to prevent the metallic edge from producing small rays of light, which are very confusing to the observer. The mirror is set in a metal frame to which a handle is fixed.

In a recent work by ZANDER,* he divides them into three classes, viz.:

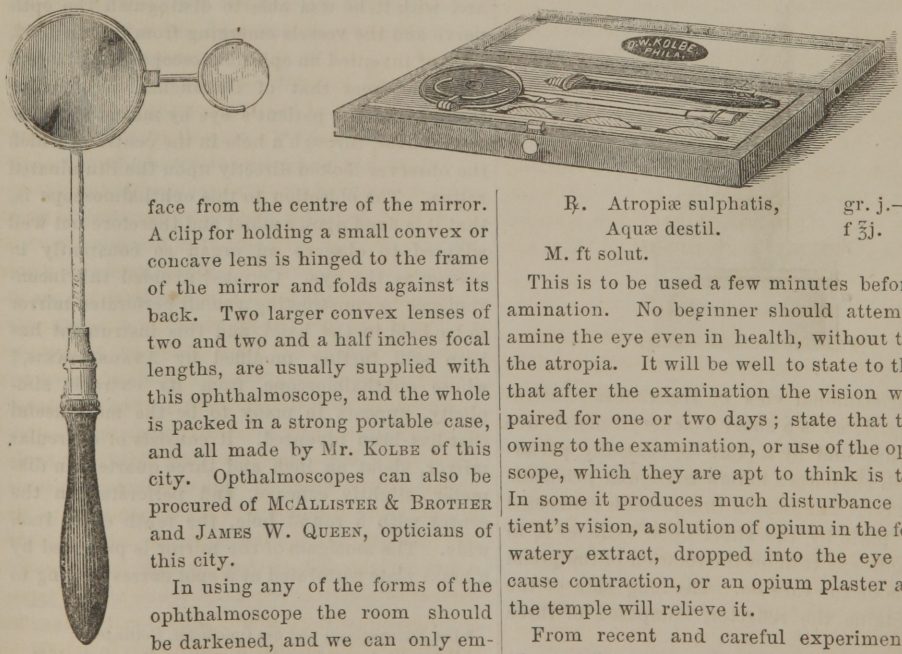
1. Ophthalmoscopes in which the reflector consists of slips of highly polished glass, with plane parallel surfaces, as HELMHOLTZ'S.

2. Homo-centric ophthalmoscopes—concave mirrors of silvered glass or metal, as REUTE'S and LIEBREICH'S.

3. Hetero-centric ophthalmoscopes—plane or convex specula in combination with a convex lens, as COCCIUS' and ZEHENDER'S.

For several years we have employed the ophthalmoscope of COCCIUS, as modified by ANAGNOSTAKIS, but more recently that of LIEBREICH as seen in Fig. 2. It is a small, slightly circular concave metallic mirror mounted on a handle, and pierced centrally with a much smaller hole than that generally made in the glass mirrors. Being of metal, an accidental fall does not break it, and the smallness of the hole diminishes to a minimum the amount of central shadow in the illumination, that results from the absence of the reflecting surface from the centre of the mirror. A clip for holding a small convex or concave lens is hinged to the frame of the mirror and folds against its back. Two larger convex lenses of two and two and a half inches focal lengths, are usually supplied with this ophthalmoscope, and the whole is packed in a strong portable case, and all made by Mr. KOLBE of this city. Opthalmoscopes can also be procured of MCALLISTER & BROTHER and JAMES W. QUEEN, opticians of this city.

Fig. 2.



In using any of the forms of the ophthalmoscope the room should be darkened, and we can only employ the artificial light a candle produces too faint an illumination.

A steady lamp flame, like that used for the microscope, is required for viewing the interior of the eye; I employ a gas lamp with a GODDARD burner, with a light blue chimney, made by CORNELIUS & Co. The best arrangement that I have seen for illumination is that at the "Royal London Ophthalmic Hospital," Moorfields. It is an Argand burner with very fine apertures, and has a piece of fine wire gauze fitted to the bottom, which subdivides the draught into a great number of small currents, which makes it very uniform. A short glass chimney, tinted blue, is preferable; a tall one produces too rapid a draught. The burner is fitted to a double jointed arm which can be raised or lowered and moved from side to side. The eye of the patient must be screened from the direct rays by a small blackened tin shield fixed to the burner.

If the pupil of the patient is dilated or very dilatable, no artificial means need be employed to produce it, but if a very thorough examination is required and the patient is past middle age, more especially if the examination is behind the iris, belladonna or its salts must be resorted to by placing a small quantity of the soft extract around the brow the night previous, or placing within the eyelids a few drops of a solution:

℞. Atropiæ sulphatis, gr. j.—iv.
Aquæ destil. f ℥j. M.
M. ft solut.

This is to be used a few minutes before the examination. No beginner should attempt to examine the eye even in health, without the use of the atropia. It will be well to state to the patient that after the examination the vision will be impaired for one or two days; state that this is not owing to the examination, or use of the ophthalmoscope, which they are apt to think is the cause. In some it produces much disturbance to the patient's vision, a solution of opium in the form of the watery extract, dropped into the eye will soon cause contraction, or an opium plaster applied to the temple will relieve it.

From recent and careful experiments of Dr. HAYDEN,* he proves the following facts: that bel-

* Zander, A., Der Augenspiegel, Seine Formen und Sein Gebrauch, Leipzig, 1859.

* Dublin Quarterly Journal, August, 1863, p. 51-54. Hay-

ladonna dilates the pupil by inducing a state of active contraction of its dilator muscles through the sympathetic, and that opium causes its contraction by stimulating its constrictor muscle through the third or *motor oculi* nerve.

"The force which presides over active accommodation is derived from the cerebro spinal system: the other, which holds under its control the tensor of the circular fibres, is the ganglionic system, on which opium and belladonna act with opposite effects, the former paralyzing them and the latter exciting them. We must not lose sight of the fact that the contraction of the radiated fibres corresponds to relaxation of accommodation as paralysis does to the maximum convexity of the lens.

"The tensor muscle of the choroid, like the iris, is composed of a crown of radiated fibres, implanted by their internal extremity upon a circle formed of circular fibres in the manner of sphincters. The radiated fibres placed under the influence of the sympathetic, contract in both organs under the reflex action of the sympathetic or by the action of belladonna. Opium, on the contrary, paralyzes them as does the division of the superior fillet of the cervoid ganglion, thus evincing the action of sphincters."

The experiments of ORFILA have shown that persons who have died from the effects of belladonna, the cerebro-spinal centre and its investing membranes are in a state of extreme vascular congestion. But we know now that belladonna may act as an excito-motor stimulant when applied to the eye, without at all giving rise to congestion of the ocular vessels. It would appear that whether applied to the periorbital and palpebral integuments, or on the conjunctiva, it acts invariably upon the sympathetic supplied to the radiating muscular fibres of the iris, through the branches of the fifth pair of nerves distributed on those surfaces as its incident medium.

The Calabar Bean.

Next in importance to the use of opium in producing effects exactly opposite to those induced by belladonna or atropia, is the Calabar bean or its alkaloid. The first notice of its effects was by Dr. ROBINSON,* of Edinburg, who states that his friend Dr. FRAZER informed him that he had seen contractions of the pupil result from the local application of an extract of the *ordeal bean of Calabar*. He resolved to investigate the action of the substance upon himself, and with some difficulty obtained the beans from which he made an alcoholic extract of various strengths; the strongest was such that one minim of it corresponded to four grains of the bean. The results obtained from his first experiments were, that the Calabar bean acted first on the accommodation of the eye, causing indistinct vision of distant objects to such an extent that all objects beyond eight inches from the eye, appeared dim and indistinct, but was relieved by the use of concave glasses. The next marked effect produced was contraction of the pupil, its diameter being reduced from two lines to half a line. He further proved by a second series of experiments, that it possesses the power of counteracting the effects of atropia, resembling opium in this particular. He thinks the most feasible explanation of the action of the Calabar bean on the eye is to regard it as a stimulant to the ciliary nerves. It is applicable in all instances where atropia is used to render the examination of the the eye more perfect or more simple. This includes two classes of cases; those in which dilatation of the pupil is either necessary or desirable to aid ophthalmoscopic examination, and those in which paralysis of the ciliary muscle is necessary, in order to ascertain the state of the accommodation of the eye. He also advises its use in cases of retinitis with photophobia, ulceration at the margin of the cornea leading to perforation, or even when prolapsus of the iris has just occurred, as well as in cases where the iris has a tendency to protrude through a corneal wound, but as yet he had but little opportunity to test it practically, which was soon done by Mr. THOMAS NUNNELEY,* of Leeds, who obtained a supply of the extract dissolved in glycerine and at once availed himself of its power over the concentric fibres of the iris, by which he observes the pupil may be reduced in size to a mere speck, and the whole surface of the iris put upon the stretch; the direction of the force being from the circumference towards the centre of the membrane. The most important application was to wounds of the cornea and sclerotic with prolapsing iris, either the result of injury or in operations by the surgeon. Many plans have been suggested for disengaging the prolapsed iris, which, though occasionally successful, far more commonly fail. It occurred to Mr. NUNNELEY that if the iris could be kept for some hours on the full stretch, by the almost entire contraction of the pupil, it would not prolapse, and thus the corneal wound might heal by the first intention. The result of two cases in which he

den on Poisoning with Atropia Belladonna and on the mode of action of Belladonna, according to Graefe. Ophthalmic Journal No. 5, p. 208.

* Edinburgh *Medical Journal* and Boston *Medical and Surgical Journal*, April 2, 1860, p. 178.

* *Lancet and Dublin Medical Press*, July 29, 1863, p. 111.

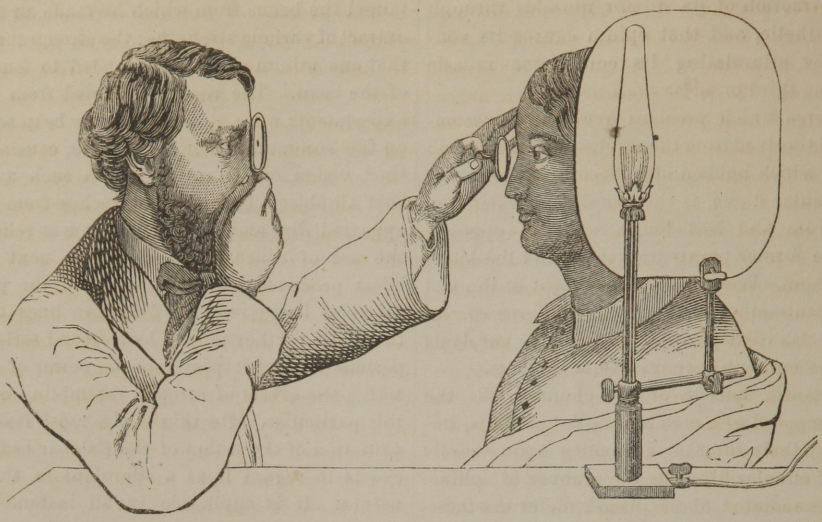


Fig. 3.

employed the bean is most satisfactory, and would quite justify the belief that if the case is seen immediately after the infliction of the injury, before prolapsus has taken place or even though this has happened, before adhesion has occurred, the iris may be kept out of the wound and this will then heal as after a surgical wound. The two cases reported were as unfavorable as possible, and the results have been far better than he could have anticipated.

Before commencing with directions for its management, I ought to mention that the ophthalmoscope, when employed alone, gives the upright picture of the interior of the eye, but when we use the lens we see an "inverted picture," so that what appears to be placed upward or inward, is in reality situated downward and outward, and vice versa, the great advantage derived from the use of the double convex lens is that by it we obtain a larger picture; but should we desire to reduce it we then can use a double concave lens. The simple mirror of Anagnostakis, used in combination with a convex glass in the manner I am about to describe, certainly allows of our seeing in their real position parts which do not fall within the focus of the patient's crystalline lens. Thus a morbid growth—an encephaloid mass, for instance—which might be seen on the floor of the vitreous chamber, would be found really to occupy that position when the globe has been extirpated. But the optic nerve and retina, lying within the focus of the patient's lens, are seen reversed; so that the axis of vision, which is really placed on the temporal side, appears to lie on the nasal side of the nerve, and an extravasation of blood, or patch of pigment below the nerve, would appear to be above it.*

Having darkened the room, the patient should be seated by a small steady table, the lamp having been lighted and placed close to the side of the head, the flame on a level with the eye, so that the face receives no direct rays by means of the side shade.

The surgeon sitting on a high stool or standing in front of the patient at about eighteen inches distance, for the indirect method, with the ophthalmoscope applied to his own eye, as seen in the cut, (Fig. 3.) receives the rays from the flame, and by a slight oblique motion reflects them upon the patient's eye, whose pupil is in a short time illuminated with a bright red glow, that changes to silvery white when the eye is turned slightly inward toward the middle line. Then holding the double convex lens by the handle as in the picture, or between the thumb and forefinger of his left hand, he places it at the distance of about one inch in front of the patient's eye, steadying it by lightly touching the orbital region with his little finger between this end and the speculum and then by a slight to and fro movement of his head he tries to catch the distance at which the inverted image of the patient's fundus is visible to him; when he has this he then begins to see the disc of the optic nerve and the vessels of the retina. You must not expect to see too much at first examination, as it requires some practice to properly illuminate

* Dixon on Diseases of the Eye, p. 777-8.—Holmes' Surgery, vol. ii. London, 1861.

even the fundus of the eye and place the convex glass in proper position. It is well to make experiments upon some of the lower animals, especially the white rabbit, which makes a most admirable subject. To be able to see the optic nerve well the patient must be directed to turn the eye a little toward the nose, and by turning slowly in various directions the whole of the fundus can be thus explored.

For the examination by the direct method, the pupil should be fully dilated, and the accommodation paralyzed with atropine; the patient and lamp should occupy the same relative positions as they do in the indirect method, but the surgeon must bring his eye within a much shorter distance of the patient's eye; an inch and a-half to two inches. In approaching so closely to the patient's eye, if a concave speculum, as LIEBREICH'S, is used, much light is cut off the outer margin of his orbit, and the illumination of the fundus is proportionately dim; but at these short distances ZEHENDER'S ophthalmoscope still illuminates brightly, and for this reason its employment is preferable in the direct examination.

Zehender's Ophthalmoscope.

"Unlike those which have been described, this consists of a convex metal speculum, in combination with a biconvex lens which is of shorter focal length than the negative focal length of the speculum. The clip which holds this lens is mounted on a jointed bracket which turns right and left on the short handle of the speculum. A clip for an ocular lens is hinged to the side of the frame just as in LIEBREICH'S small ophthalmoscope; it is however less easy to manage.*"

The eye may be illuminated by still another method indirectly alluded to before, namely, the "oblique illumination," but which cannot be carried with entire satisfaction beyond the capsule of the lens. This consists in placing the light at the side of the eye to be examined, and the surgeon will find it most convenient to stand behind and above the patient inspected, so as to get the light reflected from the crystalline lens. A double convex lens is so inserted between the eye and the light that its focus falls upon the parts to be examined. If we desire to examine the superficial reflecting medium of the eye, as cornea, lens, &c., the rays of light should be made to pass through near the centre of the glass; but should we find it desirable to examine for cataract or adhesions of the iris to the capsule of the lens, the nearer to the upper margin of the lens should the rays be refracted. No examination, however, can be complete for cataract or deep-seated lesions of the eye without the use of the ophthalmoscope. Besides the ophthalmoscopes we have already noticed, there are Prof. JAEGER'S, of Vienna, and Prof. DESMARRE'S, of Paris. Both are metallic mirrors, and only differ slightly in form. That of Prof. RAU, of Berne, is a concave mirror of glass, lined with mercury, and its focus is fourteen inches.

The Opthalmoscope of ULRICH is stated to be similar in construction to that invented by RUETE.

LIEBREICH'S large ophthalmoscope is seen in Fig. 4; it consists of two tubes, one sliding within the other by a rack and pinion. The tube next the observer, on the right, contains the speculum which swings vertically on trunnions revolving in clips in such a way that it can be easily removed and replaced. A portion of this tube is cut away in order to admit light to the speculum behind which there is a narrow slit for a convex ocular lens of low power. The tube on the left, next the patient, contains a convex lens of about two inches focal length, swung in the same manner as the speculum. This tube is encircled by a stout collar, which slides on the vertical rod, so that the whole can be fixed at any convenient height. The lower end of the rod has a clamp for fixing to a steady table. Above the collar bears a graduated horizontally sliding rod ending in an oval plate, against which the patient steadies his forehead in the manner represented in the figure. Additional steadiness is gained by a chain rest. A small brass ball mounted on a jointed bracket forms a convenient object for the patient to fix his eye upon. A couple of small blackened tin shades, not shown in the figure, cut off the direct rays of the lamp from the patient and surgeon's eyes. This instrument is very satisfactory when the focus is obtained, but it requires an experienced observer to make the arrangement, then any number of students can in turn observe the appearances. It is also useful to a teacher in making drawings. The necessity for varying the position of the eye constitutes a great objection to such complicated ophthalmoscopes, and some eyes are so unsteady and so little under the patient's control, that the observer is obliged to follow their movements by slight changes in the position of the ophthalmoscope, which can be best effected when the instrument is held in the hand. The simple instrument, when once learned, is enough for our purpose.

On the choice of an Ophthalmoscope.

According to SICHEL,* the ophthalmoscope, in

*Hulke.

* Iconographie Ophthalmologique, pp. 749-750.

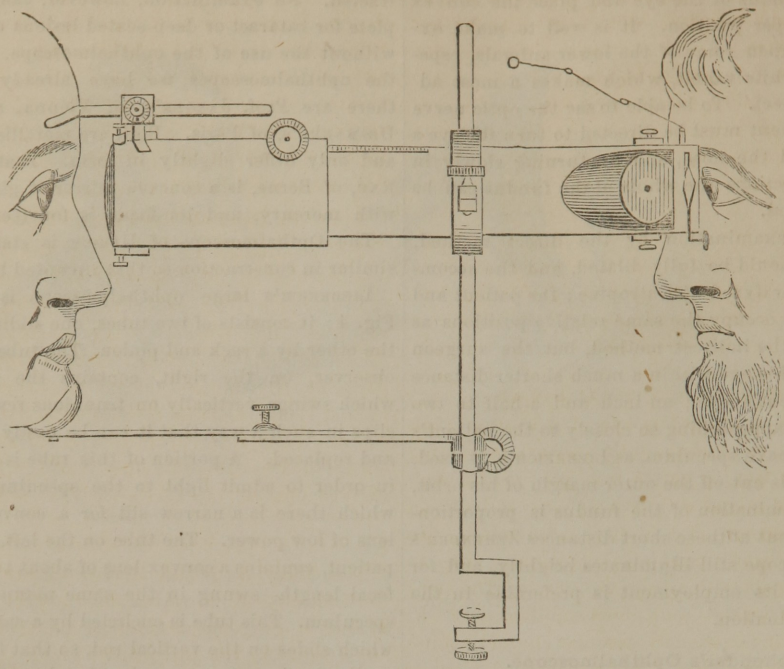


Fig. 4.

its greatest simplicity, consists of a reflecting mirror, designed to receive and bring to a focus on its surface the rays of light, and to return them according to the angle of incidence on the surface of the pupil, in such a manner as to illuminate the internal parts of the eye and render visible the phenomena which are passing in the refracting medium and in the internal membranes.

The number of ophthalmoscopes has multiplied so rapidly, that practitioners who are not ac quainted with all the modifications to which the instrument has been subjected, would find difficulty in fixing their choice. I have tried nearly all the ophthalmoscopes which have been described until now. A frequent use of this instrument has taught me, that the most convenient ophthalmoscope, the easiest to manage, and the most perfect in its results, is that of M. E. Jager, (Pl. lxix., fig. 14,) and that of M. Coccius, modified in a very important and indispensable manner by M. A. Graefe, which has adapted to it a series of concave lenses sliding into a frame. This last ophthalmoscope having been abandoned by M. de G. and adopted by me, I call it at present mine. It would be useless to describe more at length than has been done in the description of the plate. These instruments, which are at present in the hands of every body, and which are to be procured in Paris at MM. Charriere & Luer, instrument makers, and at M. Nachet's, optician. Let us however remark, that it is the concave and convex mirrors which give the instrument its true value. All ophthalmoscopes formed with a simple reflector, that is to say, a simple concave or convex mirror to project the light to the depth of the ocular globe are imperfect instruments, which rarely permit, especially to myopic eyes, seeing with entire clearness the vessels of the retina and the other fine details, normal or abnormal. These simple ophthalmoscopes, as for example, that of M. Anagnostakis, are only sufficient for the study of diseases of the crystalline apparatus in the vitreous body and those which are seated between the retina and the choroid. In diseases of the retina and of the choroid not accompanied with deposit between the membranes, the simple ophthalmoscope is entirely insufficient, above all for a myopic observation; but with the use of convex or concave mirrors to a certain result, leaving nothing to desire.

To all those specially occupied with the study of ocular diseases, I would counsel to procure for themselves one of the two composite ophthalmoscopes of which we have spoken. I give the preference to that of M. Jager above all to the large model, but the small model also is excellent above

all when it is furnished with a second mirror, with a feeble reflector, that is to say, an unpolished glass.

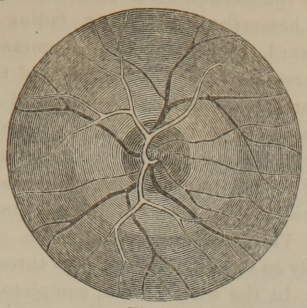


Fig. 5.

The appearance of the Retina.

When we examine the eye of a healthy individual we do not find the retina always presenting one uniform tint; it varies from pale red through shades of red mixed with orange, even to buff. In plethoric persons of a ruddy countenance, the retina is naturally redder in appearance than in that of a person with a pale complexion. The color of the retina depends on its own capillary network, and also to the extremely vascular choroid behind it. The diagram (Fig. 5.) is a magnified view of the fundus of the eye, and gives an idea of the optic disc and the central artery and vein; and by directing the patient to turn the eye a little toward the median plane, the observer will be able to trace these vessels to their parent trunks. It requires a good deal of practice to distinguish between the retinal arteries and veins. The only difference in color is that the veins are a brighter red color; this is owing to the coats of the veins which are so thin that it allows the blood to shine through them. Even this distinction between the veins and arteries of the retina becomes less marked in persons advanced in years. If we wish to produce pulsation in the retinal vessels, we must press on the globe of the eye by the finger while we are examining it, Two natural pulses, a venous and an arterial, are stated to have been seen by Van Trigt* and Dr. Ed. Jaeger.† A visible pulse in the retinal vessels is a sign of excessive intra-ocular pressure, and the arterial indicates a higher pressure.

Optic nerve entrance.

From the wood cut you would suppose the optic papella or nerve entrance was white, but this is not the case, as it is a grayish pink disc, its color depending on the amount of blood circulating in it. The recognition of the minute structure of the nerve requires great proficiency in the use of the ophthalmoscope and a very brilliant light. According to Dr. Dixon, no structure seen with the ophthalmoscope presents a greater variety of appearance than the optic nerve, even in patients who enjoy good sight.

Punctum Centrale Retinæ, or Yellow Spot.

This is situated in the axis of the eye, and is one-tenth of an inch external to the entrance of the optic nerve. To see it with the ophthalmoscope requires a high power. It is of a circular or oval figure, and is distinguished from the surrounding parts by the dullness of its image and by the greater richness of the choroid in pigment. It is the one twenty-fourth of an inch in size, and is surrounded by a broad yellow margin which gradually shades off into nearly colorless retina.

The Choroid.

The choroid is the dark tissue interposed between the delicate sentient retina, but when lit up by the mirror of the ophthalmoscope the color seen is chiefly due to the proportions of blood and pigment. If blood is in excess, the fundus is of a bright red color, but if pigment preponderate, the tinge is more of the orange. The distinctness with which it is seen depends also upon the degree of transparency of the retina. In young persons it looks as if overspread with a film, but in elderly persons they are plainly seen and of a brownish tinge. In persons of swarthy complexion the veins map out the choroid in small spaces which are deep brown with a violet tinge; this color is also found in the eye of the negro. In the albino the reflection produced by the vascular choroid is the most brilliant and lightest in tint.

Hyperæmia and Inflammation of the Retina.

"Capillary congestion of the retina first shows itself as a minute pink strippling limited to a segment, or overrunning the whole of the optic disc. As the distension of the vessels proceeds, the minute dots and streaks blend in a uniform blush, which invades the centre of the disc last. As the redness of the disc increases, its contrast with the adjacent fundus diminishes, and its outline becomes inconspicuous, or lost to view, in which case the confluence of the large retinal vessels alone marks its situation. These vessels seem to end abruptly at the surface of the optic disc, the redness and the opacity of the nerve tissue concealing their deeper vertical portions from view. The retina, unlike the optic nerve, is not reddened

* Van Trigt, A. C., De speculo oculi, ejusque usu. Utrecht, 1853.

† Jaeger, Ed., Ueber Staar and Staaroperationen, nebst andern Beobachtungen und Erfahrungen. Wien, 1854.

by simple capillary congestion, the reason being the largeness of the meshes of its capillary net.

"Its arteries are but little prone to enlargement or varicosity, and they readily elude notice; but its veins become very swollen and tortuous, and as they lie at different depths in different parts of their course, and are, therefore, overlaid by a greater or less thickness of retinal tissue, they appear in different degrees of distinctness. Thus the convex bend of a vein, which comes close to the inner surface of the retina, is plainly visible; whilst the continuous portions of the same vessel, as they dip away from the surface toward the middle retinal strata, become indistinct and tapering, or wholly hidden, and thus give the veins the appearance of being interrupted."

"The saturation of the retina with serum by reducing its transparency, produces these appearances, and the presence of more opaque inflammatory products still further intensifies them. The degree of concealment of the deeper portions of the veins is a measure of the extent in which the transparency of the retina is diminished, and in this way is a clue to the quantity and nature of the inflammatory effusion. But we possess another gauge in the degree in which the choroidal coloration of the fundus is damped, because the view of the choroid is obscured in proportion to the opacity of the retina. A little serum which only produces a faint haziness of the retina, but slightly flattens the brightness of the choroid; whilst dense inflammatory products so cloud the retina that the choroid but dimly glimmers through it, or is wholly lost to view. In this state the retina has a dull gray or stone color, blotched with rusty patches where capillary hemorrhage has taken place. These changes in the retina are accompanied with a cloudiness of the vitreous humor, which is greatest in the parts bordering on the retina, and decreases toward the centre of the humor.

"The following forms are distinguished:

1. Retinitis characterized by intense redness of the optic disc, great venous congestion, œdema and capillary hemorrhage, little tendency to deposition of lymph, and little loss of transparency of the retinal tissues or of the vitreous humor. Ret simplex, ret apoplectica. Capillary apoplexy of the retina.

2. Retinitis with less vascular turgescence, but with free infiltration of the retina and adjacent vitreous humor with lymph and corresponding great opacity. As the syphilitic and strumous retinitis.

3. Suppuration of the retina."

"Retinitis ends in resolution and recovery, or in atrophy. Where the former occurs, the distension of the swollen veins subsides, the spots of capillary hemorrhage disappear, fading from the edges toward the centre; the inflammatory products are removed, the transparency of the retina returns, and the details of the choroid are again sharply seen. The redness of the optic nerve is often last to disappear. The veins frequently retain their tortuosity, and with this exception the fundus preserves no traces of the previous inflammation. This fortunate termination commonly occurs only in the first of the above three forms of retinitis. In the second form, complete recovery occurs only where the exudation has been in limited quantity, and the inflammation has been arrested before the retinal tissues have suffered much. In a very large proportion of cases of this form, atrophy ensues, and when the vitreous humor has become sufficiently clear to allow the optic nerve to be seen, this is found shrunken, oval, or otherwise distorted, with a ragged, jagged border; it is no longer distinguishable. Branches of the large retinal vessels are observed to be obliterated, traces of them remaining in the form of thread-like lines; other branches have wholly disappeared. The fundus is blurred, the choroid is confused or wholly hidden by patches of retina of a peculiar opalescent yellowish-white color, in a state of fatty disintegration.

The third form of retinitis, the suppurative, always ends in destruction of the eyeball." *

The descriptions by the older writers of this disease, before the invention of the ophthalmoscope, were vague and uncertain, and even TYRRELL,† the great English master in ophthalmology, employs the term "acute retinitis" as synonymous with "glaucoma." The authority who is most to be relied upon is MACKENZIE,‡ who in his latest work takes advantage of the knowledge obtained by the use of the ophthalmoscope. He describes "Idiopathic retinitis acute and chronic," with "Retinitis from undue lactation;" he omits one of the most important forms, namely, "Syphilitic retinitis," which is one of the sequelæ of iritis after apparently all inflammation has passed away, leaving the cornea lens and vitreous humor transparent. The following case will illustrate this class.

Mrs. Mary D——, aged 42, applied as an outdoor patient at Howard Hospital, with entire loss of vision, January 1860. Her sight has been fail-

* Hulke on the Ophthalmoscope, p. 41—43.
† Practical Work, &c., Vol. ii., p. 146.
‡ Practical Treatise, &c., 4th London, 2d American, p. 555.

ing her since July, 1859; was a healthy woman previous to marriage, and lived with her husband twenty-one years, when he became sick. She has six healthy children, but the seventh was born covered with an eruption, and was in the Children's Hospital of this city under treatment, and the physicians informed her that he has syphilitic disease. She has had chancres on her lip and in other parts of her body of a specific character, has taken mercury, her sight failed her gradually without pain.

Ophthalmoscopic examination—cornea, iris and lens clear; optic nerve appears enlarged, irregular and of whitish texture; large irregular white patches are scattered over the retina.

Being placed upon a specific course of treatment, by the 14th she stated she felt much better, and can see the clock and the hands on it; by the 28th she could see the letters on her paper, and ultimately she was able to come to the hospital for her tonics and iodide of potassium alone. Numerous cases of this class of disease present themselves at my clinic, and the ophthalmoscopic appearances of secondary syphilis vary slightly. In some instances gray and white flocculi are seen in the vitreous space, which change their position when the eye moves. The optic nerve is seen as through a ground glass. The vessels of the retina are usually small and difficult to be seen, with red, yellow, brown, or black patches near the yellow spot.

An interesting case I saw in the London Ophthalmic Hospital is apropos to the present time in our own navy. A sailor desired to be discharged on account of loss of sight, from the Royal Navy; he was suspected of malingering, and sent by the Government officer to be examined. To look at his eyes there was nothing to indicate disease. The cornea, iris and lens were not dimmed, he had only a faint perception of light in one eye. The other was somewhat better, so that he could guide himself, but not sufficient vision to fit him for Her Majesty's service. On examination by the ophthalmoscope the whole surface of the retina was covered with black patches, and occasionally white patches of lymph were seen, which was the result of syphilitic poison, and demonstrated the utility of the ophthalmoscope.

The Diseases of the Retina in Morbus Brightii.

"The ophthalmoscopic signs are congestion, hemorrhage and slight haziness of the retina. This opacity increases the apparent size of the optic disc by confusing its outlines, and renders the vessels less distinct than natural. These seem to terminate taperingly at the surface of the optic disc, beneath which they cannot be followed. Small bright yellowish-white dots appear in the opaque retina, at first thinly scattered, but becoming confluent. They form large patches, which ultimately coalesce and overspread a considerable extent of the retina with a whitish opacity, the uniformity of which is broken by blotches of effused blood." ("Hulke" Practical Treatise, p. 50.)

The following is an interesting case from Prof. F. Horner * Anna Fischer, eleven years old, in June, 1860, suffered from an eruption of the skin, the nature of which cannot well be determined. After the disappearance of the exanthema, the child remained dull, sleepy, without appetite, suffered from constipation, and had an augmented wish to urinate; no hydrops; several weeks afterward a violent convulsive attack during the night, with entire loss of consciousness. The latter returns twice; the last time at the end of September. After the last attack vision was almost entirely lost for some days, and remained weak afterward.

The state of the patient on the 9th of November was the following: She is tall, very pale, thin, and not hydropic; pulsation of the heart very strong, visible on a large part of the left side, and disagreeable to the patient; horizontal diameter of heart considerably increased; sounds pure, urine considerable in quantity, pale, somewhat opalizing; specific weight 1005, containing an uncommonly large quantity of albumen. No cylinders of fibrine; pupil somewhat dilated, and not very movable. She reads with the right eye some words of No. XVI; with the left, letters of No. XI. Field of vision normal. The ophthalmoscope shows the typic condition of retinitis of a high degree in morbus brightii. The optic nerve was merely characterized by the ends of its veins. Its margin is not distinguished from the neighborhood, but seems one in color with the surrounding zone of grayish infiltrated retina. Arteries mostly colored, veins pretty large. The white infiltrated zone of the retina extends around the whole optic nerve, and covers the vessels. Its diameter is three times the diameter of the yellow spot. There were no apoplexies, but several deposits of pigment. Patient entered Dr. H.'s institution November 11. Ordered Tinctura ferri acet, twenty drops three times daily. During the next month the general condition of the patient considerably improved, specific gravity of urine 1010.

Much more astonishing was the amelioration of vision. After one month, on the 9th of December,

* Klinische Monatsblätter für Augenheilkunde and American Journal of Ophthalmology, Vol. i., No. 6, p. 236.

patient read No. 11 on both sides; with her left eye, words of No. 1. The margin of the papilla of the optic was more visible with the ophthalmoscope; on the left side the color of the "zone" and near the yellow spot the same; on the right side the condition remained unchanged.

The increased violence in the beating of the heart, after the patient left the institution, caused Prof. H. to give during three weeks the powder of *secale cornutum (gr. 10 pro die)*. The beating became less, but auscultation did not reveal any decrease in the size of the heart. Vision remained the same, and she read with her left eye No. 1 fluently (January, 1861.) Three months later the author saw the patient, and he found the retina had become almost perfectly normal. Ordered pills of ferri reduct, with extr. gentian, on account of anæmic appearance. At the end of 1862 patient was considered well."

Retinal Hemorrhage.

This is not an unfrequent cause of sudden loss of vision, it may be complete, or more generally a portion of the retina is involved, so that it may still perform its functions imperfectly. There is usually a strong red glare before the eye if seen early, and often deep-seated pain. The iris is motionless or sluggish if dilated, with no improvement in vision. A patient now under my care has passed the first stage, and on examination a deep-seated greenish reflection was seen in the eye, and on an ophthalmoscopic examination effusion was found upon the retina covering the entrance to the optic nerve. Such a case may be improved, but from a severe blow and the age of the patient, perfect vision will not be restored.

A young boy received a blow in the eye (causing blindness) with a snow ball, which caused dilatation of pupil, iris sluggish and pink effusion upon the retina. Treatment.—Leeching with diuretics, he entirely recovered; it required some two months' treatment. The blood in elderly persons is changed to lymph,—thus causing a whitish or dark cloud before the eye.

If the hœmorrhage is not produced by mechanical violence, as in the instance before mentioned, it proceeds, accordling to "Hulke"* from the capillary vessels, and apoplexies are more numerous behind than in front of the equator; they are scattered or crowded, in which case neighboring ones run together into patches of considerable size. Fresh blood-spots have a rich crimson color, deepest at the centre and falling off towards the edge; older ones are blacker or brownish red, rusty or buff. "The effused blood is either completely removed, leaving no trace of its former presence, or, what is much more frequent, in the sites of former apoplexies the fundus retains a confused, patchy appearance.'

Apoplexy of the Retina. This is occasionally a forerunner of an attack of apoplexy in the brain. An interesting case of this kind was related to me by Dr. Dixon. In such cases, pain is felt on the examination. In another case which I examined, there was no pain on the loss of vision, nor any on the ophthalmoscopic examination.

The following illustrative cases are from "Hulke."

R. B. A countryman, aged 40 years, dilated pupil with no perception of light, attack sudden, no cause. Directed to place in the eye a few drops of solution of the suphate of atrophia, two grains to the ounce of distilled water, it dilated the pupil well.

Ophthalmoscopic signs. The retina was found covered with diffused patches of extravasated blood. It required some four or five months before he was able to read large sized type, and the retina was left opaque and mottled. When blood escapes from the retina into the vitreous, it appears by reflected light, black, and is very slowly absorbed; in one instance it required six or seven months.

Case.—A. H., a farm servant, æt. 21, who said his health had always been good, had a sudden obscuration of the right eye whilst at work. The mist which was at first not dense, increased, so that perception of objects was quite lost. Six months after this he came to the Royal London Ophthalmic Hospital. The pupil was active. The outward appearance of the eye was good.

Ophthalmoscopic signs. The retina and choroid could not be seen. The upper hemisphere of the vitreous humour contains a gray, cloudy, floating film, with small brown flocculi below it. Whilst still lower than this, between the equator and ora serrata, there was a large dark mass, which, when obliquely illuminated, had a deep crimson color, and was evidently a large blood clot.

Case.—E. M., æt., 21, a gardener was admitted to the Royal London Ophthalmic Hospital. Three months previously, whilst stooping to clip a box-row, his right eye was obscured to such a degree that he could not discern objects. I could not discover anything wrong in the external appearance of the eye. The retina was just sensitive to light.

Ophthalmoscopic signs. Extensive retinal apoplexies hiding the entrance of the optic nerve, and large clots in the vitreous humor."

* Hulke on the Ophthalmoscope, p. 43.

Case of Hemorrhage of the Retina.

"The patient had observed on awakening suddenly that he was completely blind of the left eye which had been healthy until that time. He visited Dr. Richard Leibrech, fifteen days after. He could distinguish, but with much trouble, the number of fingers which he presented in an excentric direction, but had in the remainder of the visual field very little impression from the light. With the ophthalmoscope could be seen from the extreme periphery to the bottom irregular ecchypomosis, which seemed to transmit the different layers of the retina. In the intervals, between the spots, they were not, altogether normal, but were irregularly scattered over with little red spots. The main arteries were shown entirely empty of blood, and changed into white cords, the others full of coagulated blood. The circulation had only remained free in some branches. As to the veins, they were for the most part empty. A single branch showed itself nearly normally full. Similar hemorrhages of the retina in old men are very common, from the extraordinary prolonged duration of spots of blood, which only change themselves very slowly, little by little, and finally are lost by being partly reabsorbed and partly converted into dark spots.*

Retinitis Pigmentosa.

This is a malady which characterizes infancy, there is a diminution of the visual field, also between the ages of 3 and 4, cachexia complete, in consequence of gradual retrenching of the visual field.

I have remarked for the last two years that these patients are the children of consanguineous parents. Many similar cases have confirmed me in this opinion by the ophthalmoscope; we notice at first, modifications in the choroid.

These consist in young subjects in irregularities difficult to see in the epithelium. In more advanced subjects these last occupy nearly all the bottom of the eye, and the epithelial cells seem completely wanting in some places. There exists beside modifications in the stroma and the vessels, the former is more pigmented, altogether. But there are places where the pigmentations are very deep. It follows that the passage of the choroidal vessels are sometimes scarcely perceptible, according to the degree of pigmentation of the stroma which they traverse. The vessels have a calibre very irregular. On aged subjects they are often completely obliterated in a certain extent and transformed into small and yellow cords. The alteration which strikes us the most is the pigmentation of the retina. It is in a zone which surrounds the macula lutea and the optic nerve, it extends generally more inside and becomes larger with age.

It consists of very intense black spots, of a very varied form, which is composed of very fine points. An attentive observation recognizes isolated cells; sometimes they are very sparse, sometimes they are reunited so as to form a net-work of small vessels.*

The ophthalmoscope alone enables us to detect it.

Detached Retina, Floating Retina, Hydropsie Sous-Retinienne.

Projecting inward from the choroid, before it loses its transparency, the detached retina is recognized with the ophthalmoscope as a delicate bluish membranous vesicle, tense or folded, vibrating and undulating with the movements of the globe, and displaying the ramifications of the retinal vessels; after a time it becomes opaque, pearly white from fatty atrophy of its tissues. Its color is dependent on the quality of the fluid behind it, which fluid may be the consistency of jelly. Always highly albuminous so that it is solidified by heat and nitric acid, containing at times flakes of lymph which coat the inner surface of the choroid. These lymphy or fibrinous deposits are transformed into a fibroid tissue.

The commencement of the detachment of the retina is often very insidious. It almost always begins at the lowest part of the fundus, in the equatorial region. It retains for a time a slight degree of sensitiveness, but this is soon lost. It may remain stationery at one point, or it may steadily progress until the whole membrane is stripped from the choroid, and pressed toward the axis of the eye-ball taking the figure of a funnel. The vitreous humor disappears, the retina occupying its place; what remains becomes hazy fluid and charged with gauzy films.

Detached retina may be confounded with waving opaque films of floating hyaloid or decolorized fibrinous clots in the vitreous humour. The presence and arrangement of the retinal vessels will assist in the diagnosis. They also assist in distinguishing morbid growths behind it. Von Graefe has stated, that it must be borne in mind that in cancer of the choroid is at some periods productive of retinal detachment, and this may

* Atlas der Ophthalmoscopic von Dr. Richard Liebrech, Berlin, 1863, p. 21.

* Atlas D'Ophthalmoscopie Representant L'Etat Normal et Les modifications Pathologiques. Du Fond de L'œil visibles. A L'ophthalmoscope. Par Le Docteur Richard Liebrech, p. 15

Berlin, 1863, Paris, Germer, Bailliere.

mask the primary disease. The tension of the globe will assist the diagnosis, as the eye-ball is usually soft in detached retina, and firmer and harder in cancer.

Detachment of the Retina.

Recent detachment of the superior half and perforation of the retina The portion detached is prominent, smooth and sufficiently stretched, and only reflects a little light. As the liquid epanche enters the retina and the choroid is transparent, we perceive at the bottom the red, but it seems veiled, on the inferior limits of the detachments.*

Serous effusion between the Retina and Choroid

This occurs as the results of acute or chronic inflammation, if it be the result of acute inflammation, it takes place as a morbid result of diseased choroid termed "glaucoma," or it may be from a blow upon the eye, or of chronic inflammation with loss of vision. There is pain in the early stage of "glaucoma," also in cases from violence, but there is no pain in the cases of chronic effusion. There are no external signs by which we can ascertain the existence of effusion beneath the retina.

Choroido-Retinitis Pigmentosa.

"The ophthalmoscopic signs are black specks and flocks of every conceivable shape, at first scattered, but subsequently as they become more abundant, running together into a tangled web, the stronger lines of which often accompany the retinal vessels, which are much reduced in size. The choroid in the meshes of this web is poor or wholly deficient in pigment. These signs first appear near the ora-serrata, spread very slowly backwards, and finally those of atrophy of the optic nerve are superadded. Nothing is learned from the outward aspect of the eye, until amblyopia occurs, when the pupil becomes large and sluggish, and night blindness occurs.†

Dr. Leibreicht‡ was the first to draw the attention of the medical public to the fact that the disease known as *retinitis pigmentosa* was frequently combined with "deaf-muteness, idiotism, and madness."

Granular Meningitis.

The ophthalmoscope has also been found useful in the diagnosis of "granular meningitis."§

Twenty-three cases of meningitis have been examined in M. Bouchut's Clinic. The changes in the eye-ground, observed in these cases, were:

1st. Peripheric congestion of the optic nerve and congestive exudations in the retina and choroid.

2d. Dilatation of the veins of the retina around the papilla.

3d. Varicosity and flexuosity of those veins.

4th. Thrombosis of those veins.

5th. Retinal hemorrhages in consequence of rupture of veins in some cases.

The papilla is always less distinct; its circumference is diminished in consequence of the surrounding congestion. In one case, cerebral symptoms had raised the suspicion of meningitis, and the ophthalmoscope showed the characteristic symptoms. The cerebral symptoms subsided entirely, but the child died twelve days afterwards, in consequence of general tuberculosis. The post-mortem showed that ophthalmoscopic examination had not deceived, for there existed a great number of meningeal tubercles.

M. Robin examined, at the request of M. Bouchut, a number of the eyes microscopically. He found the retinal veins dilated, sometimes containing clots, sometimes ruptured in consequence of hemorrhages. Once the internal and middle tunic of a vein was broken, and the vein dilated at that point presented a kind of aneurism. In one case, the papilla was irregular; another time, white patches, looking as if the tissue had undergone fatty degeneration, appeared; in three cases, at an examination shortly before death, a discoloration of the eye-ground led to suppose an anæmic condition, while previously congestion had been found.

The congestion of the deep membranes of the eyes Mr. B. explains in the following way: "The veins of the choroid and retina," he says, "issue into the *sinus cavernosi*, and as soon as the flow of blood in the different sinuses of the *dura mater* is impeded, the circulation of the veins of the deep coats of the eye must be influenced correspondingly by it, and necessarily the circulation in the sinuses of the membranes of the brain is rendered more difficult in meningitis, either by the great congestion or thrombosis of the various intra-cranial sinuses."

Glaucoma.

In a previous paper in this Journal,* I have given a careful abstract of the three Memoirs on Iridectomy in certain form of Iritis, Choroiditis and Glaucoma, as found in the translation of Dr. A. Von Graefe's paper, published by the New Sydenham Society, edited by Thomas Windsor, Esq., of Manchester, (Eng.) My present object is to give briefly the objections urged by a Reviewer,

* Hulke. † Ibid. ‡ Homberger.
§ Gaz. de Hop., Oct. 1862, and Am. Jour. Oph., May, 1863.

* Medical and Surgical Reporter.

in the *Dublin Quarterly Journal of Medicine*, and that of Dr. JACOB in the *Dublin Medical Press*, (August, 1860.)

The Reviewer, after five and a half pages spent as an introductory, as a general onslaught upon quackery in every form, but especially that which refers to incurable diseases, with special reference to the disinfecting colonel and assumed chemist who was sent by Government to disinfect Ireland, he goes on to state, that in August, 1847, we then fearlessly exposed the humbug of these pretenders.

Another serious fault, according to the Reviewer is, that "our journals abound in reports collected, perhaps, by but moderately educated men, and even students, of what falls from a physician or surgeon as he passes from bed to bed, and of that desultory nature which is never intended for publication; with these are interlarded the skeleton reports of cases, the results of which never meet the public eye. We have reason to believe that these proceedings do more to depreciate than to elevate medical literature. These observations suggest themselves to me upon consideration of one of the last innovations in special medicine—iridectomy in glaucoma. It is right to tell my readers that the term iridectomy is simply the making of an artificial pupil, or enlarging a natural one by that method in which a portion of the iris is cut out, an operation first recommended by REICHENBACH in 1767, and shortly afterward performed by the elder WENZEL, and which is known in books under the name of correctomia or iridectomia. As employed by the modern iridectomists, it means making an aperture either in the cornea in front, or in the sclerotic behind the ciliary attachment of the iris, withdrawing a portion of that texture, and cutting off from a fifth to a third of its circumference; there is, therefore, nothing new in the operation, except, perhaps, the amount of iris removed."

The Reviewer then defines "glaucoma as the disease known to our forefathers as non-cerebral, but generally total amaurosis, with partially dilated pupil, insensible to light; color of iris either natural or assuming a slaty hue; parts within the pupil of a sea-green muddiness, sometimes partaking of a bluish tint, congestion of globe manifested by turgescence of external veins; in some cases hardness of globe, but this is a very variable symptom. This disease occurs most frequently in aged people, and more commonly in females than in males; it first attacks one eye, and generally seizes on the other subsequently."

"That is what we know by glaucoma; coming on slowly, and unattended with the manifestations of inflammation, it may be termed chronic glaucoma. In process of time the lens frequently becomes opaque with slight irregularities of pupil; hence TYRRELL'S definition of 'glaucomatous cataract.' The disease in this stage is generally painless. The term 'acute glaucoma' has been applied to a peculiar form of arthritic, internal inflammation of the eye, arising suddenly, attended with great pain and total loss of vision, and having its principal seat in the iris, choroid, and retina, without much effusion of lymph; pupil generally dilated, and loss of choroidal pigment frequently occurring during the progress of the disease. Like the former, it is nearly always fatal to vision."

He then takes abstracts of the writings of half a dozen good practical men, but finds "the true pathology of the disease has not been very well made out. First, was it a 'scum' behind the pupil; then that the seat of the disease was in the vitreous humor, which became green; then it was supposed deposits took place in the vitreous body; others, and with reason, attribute the greenish reflection to the want of pigment in the choroid. He entirely omits effusion between the retina and choroid. Lastly, the ophthalmoscope has been brought into use, and finds a hollowed or cupped appearance in the entrance of the optic nerve, a peculiar condition of the retinal vessels within the limit of the papilla, and pulsation in the arterial trunks. EDWARD JÆGER first pointed out some of these peculiarities; but long before he wrote MACKENZIE had noted a change in the retina, and in dissection found no trace of limbus luteus or foramen centrale. The matter stood nearly thus until about four years ago, when Dr. A. VON GRAEFE, of Berlin, published some essays upon the subject in the *Archiv für Ophthalmologie*, wherein he attributed to intra-ocular pressure the condition of the optic nerve, the hardness of the globe, and also, by producing paralysis of the nerves supplying the iris thus causing the dilatation of the pupil."

The last paragraph is all that the reviewer allows Dr. VON GRAEFE, which, to say the least of it, is giving him too little consideration in a review of his own essay of 133 pages.

He then goes on to state—"That there is increased secretion of both aqueous and vitreous fluid in certain diseases of the eye, all will admit; and that this increased bulk within the globe must, by pressure, affect the retina and choroid, no one can deny; but whether it was the orignal cause of the alteration in the optic nerve, in either acute or chronic glaucoma, has not been proved." Neither is the Reviewer able to show any facts or

cases to disprove the careful statement of Dr. A. Von Graefe."

He then passes to the treatment.—"That the evacuation of the aqueous fluid, and possibly some of the vitreous with it, will give some prompt relief in certain forms of internal inflammation of the eye, every ophthalmic surgeon is well aware. There is nothing new in that procedure." He then quotes the opinions of Ware, Wardrop, and Dalrymple, but the operations of these gentlemen have been almost given up by ophthalmic surgeons, and not recommended by them in glaucoma; he even quotes himself as recommending the tapping of staphyloma (in 1847) as causing immediate relief, yet offering no better explanation of the rationalii.

"But then, we are told it is not the mere letting out of the vitreous or aqueous fluid, but the cutting out of a portion of the iris, that relieves the pressure and effects the good," (these are the Reviewer's own words, not Dr. Von Graefe's, for he is not allowed to speak in this connection, except in the garbled language of the Reviewer.) "We," he remarks, "are stupid enough not to see this in the same light as our neighbors; no doubt, a wound made for the removal of a portion of iris, even if none of that membrane remains in it, will not close so accurately nor heal so quickly as a puncture made by a broad needle; but if the pupil is free, the iris cannot by its presence or bulk exercise any pressure on the optic nerve. We are, however, entering upon the discussion of a subject, the advocates of which answer us by an appeal to facts—published," or records of the cases, with the cures; and, therefore, there is no need to argue the question, (and where does he go for his facts, not a single one from Von Graefe, but an attempt to throw ridicule upon the operation by caricaturing the author of it,) but let him speak for himself. "There never was, perhaps, any theory or operation taken up so quickly, spread so widely or upheld so firmly, as the cure for glaucoma; certainly, none since Stromeyers' recommendation, and Dieffenbach's operation for the cure of strabismus, with *perhaps the exception of cutting a wedge-shaped piece out of the dorsum of the tongue for the cure of stammering, another Berlin discovery.*

"Before we come to the question of the general utility of iridectomy in glaucoma, even if successful, it is worth inquiring how the epidemic spread so rapidly, we believe the answer is chiefly to be found in the man, Graefe, son or grandson of the celebrated baron distinguished in Prussian surgery, one of the tribes of prophets, the natural heroes of idol-worship, who ever collects disciples and always inspires them, while others only teach; young, handsome, long-haired, dark-eyed, clever, kind, hospitable, winning, the word of such a man is law; his knowledge is great powar; his opinions are regarded as revelations; his statements are never questioned." He then takes leave of Von Graefe and passes to his followers, who are "half caste doctors, after finding that iridectomy for glaucoma was not performed either at the city of Dublin (Dr. Jacobs) or St. Mark's Hospital (Dr. Wilde's), went about saying that the Dublin Ophthalmic School was the lowest in Europe: (this is certainly a confession that they have never tried the operation; therefore, neither of them can have any personal experience, and there is no wonder so much bitterness is shown to Von Graefe and his Iridectomy for injuring the Dublin School."

After this he goes for his facts alone to the statement of the London Ophthalmic Hospital, Moorfields, to whom it is well known that they adopted for a time their own operation and not Dr. Von Graefe's, as may be seen in the Ophthalmic Hospital Reports, April, 1858, by a letter from Von Graefe, with special reference to Mr. Critchett's having misunderstood and consequently misstated the theory and practical details of his operation for glaucoma, and yet the reviewer takes these cases, operated upon by Dr. C., and reported by Dr. Bader, as his chief means of judging of the results of the operation, while he does not give a single one of the seven carefully recorded by Dr. Von Graefe. In most of the case operated upon by Mr. Critchett, and even some of his colleagues, they left a portion of the iris in the wound. Thus, according to Dr. Von Graefe's experience, the cure is retarded; he never leaves a portion of the iris in the wound. (The publication of Mr. Critchett was in 1854–58.)

The Reviewer then states that—"As yet we have not had any *cures* recorded in this country, (Ireland,) and, therefore, when requested by the editor of this Journal to write a review of the subject, we had collected a series of cases (why were they not given?) recorded in England, for the purpose of analysis; but we are saved the trouble, for in the last number of the 'Ophthalmic Hospital Report' the murder is out, and Dr. Bader presents us with a resumé of fifty-five cases, in which eighty-four (not seventy-eight) eyes were operated on; and in a table attached to the report, the following results are acknowledged: Nineteen were cases of chronic, twenty of sub-acute, and sixteen of acute glaucoma."

As he does not give even a fair statement of Dr.

B.'s cases, and brings but the history of one case himself, which was not operated upon by himself, but by some one else, and which he states was not glaucoma, (simply on the rational signs, no ophthalmoscopic examination being given,) I feel that any further notice of his remarks will be but doing injustice to Dr. B., who I know is one of the most expert and honest ophthalmoscopist, that I met with in England or France, and entirely reliable in all his statements. The Reviewer also makes an extract from the work of Dr. DIXON, who he states is a thoroughly honest, practical man, yet this same gentleman did not hesitate to operate, but unfortunately he did not select his cases as VON GRAEFE stated, nor did he operate as recommended, through the schlerotic, as in his own statement will show, in which he writes: "I cannot, however, attribute this result (namely, that inflammation seemed to be arrested, and the neuralgia was either very much lessened or it wholly ceased,) to the removal of a portion of iris, but mainly to the evacuation of the aqueous humor through the large *corneal wound*."

The following are the true results of Dr. BADER, as published by him, of 84 cases. These consisted of three distinct classes, acute, sub-acute, and chronic glaucoma.

Chronic glaucoma, 29 cases, operated on by iridictomy. Remained unchanged, 18; not as good as before operation, 1; improved, 10.

Sub-acute glaucoma 29 operations. Remained unchanged, 10; made worse none; improved, 19.

Acute glaucoma 26 operations. Unchanged, 5; made worse, 1; improved, 20.

Total 84 operations—made worse, 2; not benefitted, 33; benefitted, 46.

In the *Dublin Medical Press* for April 18, 1860, we find the following by its editor:—

"The Sydenham Society, to whom our readers are deeply indebted for information which they never could have had without its assistance, are now indebted to it for an introduction to Dr. GRAEFE, of Berlin, hitherto obscured from view by a crowd of admirers anxious to cultivate celebrity by reflection. The most approved method in our times to realize an ophthalmological reputation has been to leave the native soil with as little knowledge as possible of the eye or its diseases, to take packet and sail for Berlin and Vienna, there to remain for a few months and to return and write a book of travels. But why Germany has been considered an ophthalmological hotbed in which to grow mushrooms for the English market, we cannot for the life of us tell; for we venture to say that it exports annually some of the worst eye surgery in Europe; in fact much of it is not eye surgery at all, but a strange compound of pedantry and dogmatism. We have now been going on with this Germany worship for sixty years, from BEER to GRAEFE, and in all that time we cannot find that any of the heroes of the worshippers have appeared amongst us in an English dress, except a learned writer of the name of WELLER, who put together one of the worst eye books ever printed. Far be it from us to say anything in disparagement of our German brethren, for they are very honest fellows or used to be, but we would gladly see them cultivate eye surgery like surgeons, and not like ophthalmologists, and would rejoice to find them abandon iridectocomical nomenclature, and call things by their right names.

He concludes his notice of iritis, and his method of operating for artful pupil, but without entering upon the subject of iridectomy by the following caution:

"The remainder of this paper of thirty-four pages is occupied by a diffusive rambling discourse on the consequence of inflammation of the eyeball, noticing them under all the terms and names which the pedantry of technical phraseology permits, to which we must refer our readers; on a future occasion we will take up another of these 'apologies for iridectomy.'

In the meantime we would not deter surgeons from trying the operation on patients 'stone blind;' it can do them no harm, and may possibly do some of them some good; but when a poor man with some chance of recovery comes in the way, we counsel caution."

On Iridectomy in Glaucoma.*

"There has recently appeared in the *Dublin Quarterly Journal of Medical Science*, a review, intending to discredit the treatment of glaucoma by iridectomy, as advocated by VON GRAEFE; and as this treatment seems to me of the utmost value in a class of cases hitherto little or not at all under control, but leading sooner or later to hopeless blindness as confessed by the reviewer himself, I think myself bound to offer some remarks upon it; for I believe I was the first (in May, 1857) to apply this treatment in England, and having soon convinced myself of its importance, I have since constantly advocated its general adoption in the cases to which it seems reasonably applicable.

It is impossible within the limits of such a paper as this to enter at large on the numerous

* *Medical Times and Gazette*, London, August 25, 1860.
By WILLIAM BOWMAN, F. R. S., Surgeon to King's College Hospital, and to the Royal London Ophthalmia Hospital, Moorfields.

questions opene by the brilliant researches of the Berlin professor, as to the essential nature of the glaucomatous process, the modifications it assumes in persons of different ages and constitutions, its acute and chronic forms, and its relations to disease of other kinds occurring in the eye or in the system at the same time. These will furnish abundant material for the labors of the coming time; at present, we are concerned with the practical question: How are we to treat the patients of to-day? The reviewer says they are to be treated as they have hitherto been treated, while he allows their incurability by such methods. "Chronic and acute glaucoma, he says, are nearly always fatal to vision." He rests so firmly on his prejudices as not to have thought it worth while even to try the new practice, styled by him the "glaucoma dodge," which he informs us, "to the honor of the Dublin School, was openly and fearlessly denounced by the *Dublin Medical Press* on February 10, 1858, that is, before it could possibly have been submitted to any practical test. What is worse in a man of science and intelligence, he now disparages the treatment on *a priori* grounds, after the world has had three years of the most positive testimony of facts in its favor, and he claims credit for dullness in not appreciating what is already acknowledged to be most excellent by the ablest ophthalmologists of Europe. But I most of all lament that he should have mentioned, in terms of personal disrespect, the distinguished author of this method, one who has borne so eminent a part in transforming the ophthalmic knowledge of 1850, into the far more advanced, and more scientifically-based ophthalmology of the present day. The profession in Ireland, and even in England, is interested in discountenancing this tone and attitude in one professing to speak in its name; and were it not that the review is understood to have proceeded from a high and most respectable authority, and has been distributed in a separate form, it might have been better to let it pass in silence."

*"The progress of truth, however, is proverbially slow; and, accordingly, there remain several ophthalmic surgeons, men whose ability and candor I am far from questioning, who, to judge from their latest published writings, and from cases I constantly meet with in private, in which they have been consulted, either have not yet made themselves familiar with the nice discrimination of the glaucomatous state, or who reject this inestimable means of controlling it. The consequences to patients are, of course, to be deplored. For it is natural, under these circumstances, that that large number of practitioners who only meet with these diseases among others in the course of ordinary practice, and who yet, as a body, are in the habit of seeing a very great proportion of all the cases of it in their earlier stage, should be perplexed, should discredit the reality of the benefit, and should content themselves with the old and common treatment, under which it is certain that valuable time must be lost. According to the activity of the disease, are hours, or days, or weeks of critical moment; and it is mournful to have still to pronounce, in too many instances, the fatal words: "*Too late;* at an earlier period sight could have been rescued."

Whatever the essential nature of the glaucomatous state, we, as practitioners, are chiefly concerned with the *augmented tension of the eyeball* which attends it. This we have to distinguish at the earliest stage, and towards the mitigation of this our treatment is to be directed. As a practitioner, having to relieve disease, I call *all undue tension* of the eye *glaucomatous tension.* The object of treatment is to reduce this within natural limits; for, if it continue, the result is inevitable, however delayed.

A person unused to close and accurate examination of the physical condition of the eyeball, even though he be seeing eye diseases frequently, may readily fall into error on this important matter of *the state of the globe as regards tension.* He may suppose that the increased tension may depend simply on the degree of fullness of vessels, or on the amount of effused fluids within the eye. No mistake could be greater. It cannot be too strongly impressed on all who may have to discriminate between glaucomatous and other diseases, that the depth of redness of the eye, or the presence of more or less of effused blood, or serum, or lymph, or pus within it, has no connection whatever with the question of tension, since all or any of these may be present in a high degree without any glaucomatous disease, any increase of tension, and, therefore, without the indication such tension gives for its relief by iridectomy.

In various congestive or inflammatory states, whether of cornea, sclerotica, choroid, iris, or retina, or of some or all of these, the disease may be of more or less intensity, may run its course more or less rapidly, and may do permanent damage to the structures involved, without our detecting any augmented tension of the coats at any period. Intraocular hemorrhage, as a rule, even when considerable, are not attended by a higher tension; often, indeed, by a dimished size of the globe contents, and an unnatural softness of the eye. Subretinal effusions of blood or serum are, in the great majority of cases, unmarked by any increase of tension.

On the other hand, exalted (or glaucomatous) tension may occur, intermittently or persistently, in eyes which afford no indication whatever of inflammation, where there has never been any pain or vascular excitement, and where there is still an absence of inflammatory effusions. Such augmented tension, though slight in degree, may effect by long continuance, and without any intercurrent inflammatory complication, what a pressure more intense will effect in a much shorter time, especially if, as then usually occurs, it

* Abstract of a paper read at the Thirtieth Annual meeting of the British Medical Association, by Wm. Bowman, F. R. S.—*American Journal of Ophthalmology*, November, 1862.

becomes complicated with subacute or acute inflammatory action.

I must add, however, to avoid the risk of misconception, that various affections of the eyes, not glaucomatous in their origin, may present in their course glaucomatous complications—*i. e.*, become combined with an augmented tension of the eye, and with the secondary results of pressure; and hence that it is of the highest importance in practice, to distinguish accurately whether, and when such complication has arisen, since, under several contingencies, it may need the application of irredectomy.

Thus, the idea of inflammation must be dissociated from that of glaucoma and glaucomatous tension. Though often combined, and the combination then of the greatest importance, yet their coexistence is not essential to the presence of either: and, as a matter of fact, they occur independently of each other every day.*

It is now my constant practice, when defective vision is complained of, to ascertain almost at the first instant the state of tension of the eye. To do so strikes at once home to the diagnosis. If undue tension exist, there are also its great and peculiar risks; and the question of its relief by a surgical proceeding, at once arises in the mind. Though it does not necessarily follow that this must be performed, the scope of inquiry is greatly narrowed. The use of the ophthalmoscope probably soon decides in a positive manner the cause of the blindness, and the details of the case are speedily filled in.

It is easy enough to estimate the tension of an eye, though there is a right and a wrong way of doing even so simple a thing. I may, therefore, explain that *both forefingers* should be used together through the upper lid, which is to be gently closed. One finger steadies the eye by pressing against it with a suitable degree of force, while the other estimates the tension; or, rather, both together estimate it when thus used in concert. I tell the patient to *close the eyes gently as if asleep;* and the fingers are then applied to the upper part of the globe, behind the corneal region. If the patient *forcibly* compress the lids, the mere action of his muscles may cause a momentary tension of the eyeball as well as interrupt the examination. If the eyeballs are deep-set or small, the determination of the tension is less easy. With medical men, the touch is already an educated sense, and a very little practice will suffice to apply it successfully to the eye.

I have long paid special attention to the subject of tension of the globe,† and particularly since it has assumed so much additional importance in the last few years. I have found it possible and practically useful to distinguish nine degrees of tension; and, for convenience and accuracy in note-taking, have designated them by special signs. The degrees may be thus exhibited.‡

T represents *tension*, ("t" being commonly used for "tangent," the capital T is to be preferred.)

Tn, *tension normal*. The interrogative, ?, marks a *doubt*, which in such matters we must often be content with. The numerals following the letter T, on the same line, indicate the *degree of increased tension;* or, if the T be preceded by —, of *diminished tension*, as further explained below. Thus:

T 3. *Third* degree, or *extreme tension*. The fingers cannot dimple the eye by firm pressure.

T 2. *Second* degree, or *considerable tension*. The finger can slightly impress the coats.

T 1 *First* degree. *Slight* but *positive increase of tension*.

T 1 ?. Doubtful if tension increased.

Tn. Tension normal.

— T 1 ?. Doubtful if tension be less than natural.

— T 1. First degree of reduced tension. Slight but positive reduction of tension.

— T 2. } Successive degrees of reduced tension,
— T 3. } short of such considerable softness of the eye as allows the finger to sink in the coats. It is less easy to define these by words.*

In the very limited time allotted to me, I cannot pretend to do more than glance in the most summary way at what most interests us as practitioners.

The cases of glaucomatous disease in which it is most difficult to appreciate the applicability of iridectomy are those of *very chronic and insidious course*, (the chronic glaucoma, and the amaurosis with excavation of the optic nerve, of Von Graefe; the simple glaucoma of Donders,) where the increase of globe-tension either is slight, variable, and more or less intermittent; or, if it at length comes to be considerable in degree, does so by such gradual steps that the tissues of the eye slowly accommodate themselves to the results of the pressure, and the optic nerve passes through its atrophic changes without any excitement of the vessels, without pain, without any active symptom whatever. If one eye continue sound, the patient may thus lose most or all of the sensibility to light in the other retina without being aware of it, of course, a similar loss may occur from other causes than glaucomatous tension;) and he may often first make the discovery when the better eye begins to fail. More often, however, both eyes fail together, with equal or unequal steps. The slowness of the progress towards blindness, the absence of any urgent symptom, the fact that vision in the centre of the field frequently remains good to a late period, while the marginal portions of the retina are more and more decaying, often the age and feebleness of the patient, his despondency, and the protracted anxiety of friends, may disincline us from advising an operation, especi-

* Professor Donders holds the same view. (*Vide* Haffmans, *Bijdrage tot de leer van 't Glaucoma.* Utrecht, 1861. See also Galezowski, *Annales d'Oculistique*, vol. xlvii., p. 252.)

† See my Lectures on the Parts concerned in the Operations on the Eye, etc., delivered at Moorfields, in 1847.

‡ Since this paper was read, I have simplified the signs, with the concurrence of my friend, Professor Donders, in order to adapt them for general use. The simplified form has been substituted above.

* In common practice, some of these may be regarded as refinements, but, in accurate note-taking, where the nature and course of various diseases of the globe are under investigation, I have found them highly serviceable, and they have as much precision as perhaps is attainable or desirable.

It is also to be borne in mind, that the normal tension has a certain range or variety in persons of different age, build, or temperament; and, according to varying temporary states of system, as regards emptiness or repletion. Experience will make every one aware of these varieties, which do not encroach on the above abnormal grades of tension. Medical men may understand how important is this matter of the degree of tension by considering how priceless would be the power of accurately estimating it by touch in the case of various *head affections.*

ally if the other eye still sees perfectly. The question of an operation, indeed, often is not raised until the retinal and other tissues have already undergone much change, and when, therefore, less recovery of structure can be expected to follow the relief of tension.

The result obtained is frequently only the retention of what little vision may yet remain; and the patient may still appear, and, in fact, feel very like a blind person. During the last five years, I have had the responsibility of advising in very many such cases. In the more advanced stages, I have not felt able to urge the operation strongly; and yet I have recommended it as the only means of saving the little sight remaining. Where there is more sight left to be preserved, the operation is to be more insisted on; but, unfortunately, the patients not being so blind, are often less disposed to submit to it. The progress of structural changes in the eye, marked by narrowing of the visual field, should induce us to urge iridectomy; and the earlier we perform it, the better chance there will be of deriving improvement; for we cannot recall the activity of nerve-fibres that have undergone complete atrophy.

The *subacute form of glaucoma*—glaucoma with subacute inflammation (Donders)—is one in which iridectomy is *to be urged* without unnecessary delay. Its results have been most encouraging; and a large number of cases, in which all glaucomatous symptoms have permanently subsided after its performance amply attest its value. Did time permit, I could relate numerous instances of persons thus affected, who, I have no doubt whatever, would long since have been totally blind, but for the timely aid thus afforded them. Here relief to circumocular pains, and an extension of the contracted visual field, may be anticipated; while the retina also becomes more acutely sensible in parts in which the perceptions were previously dull. This amelioration may continue to advance for many weeks, even for months or years, subsequent to the operation. It will be great in proportion to the earliness of the period at which the operation is resorted to.

But in the *acute form of glaucomatous ophthalmitis*—acute glaucoma, (Von Graefe,) glaucoma with acute inflammation of the globe, (Donders)—iridectomy should be performed *without the slightest hesitation or the smallest delay.* Here every hour is precious, the urgency being measured by the intensity of the inflammation. The loss of sight results partly from the presence of inflammatory products in the substance of, and in front of, the retina; but also from the altered circulation in the nervous structure, and the intense pressure to which it is subjected. The operation relieves from both. The inflammatory state is allowed to subside; and the products of inflammation then undergo gradual, often very rapid absorption. In addition, the eye is left without that exalted glaucomatous tension which probably preceded the outburst of the acute attack, and formed from the first the essence of the disease. If in any case this acute form of ophthalmitis is absolutely abrupt in its onset, unpreceded by premonitory symptoms, (which I doubt,) I am still disposed to distinguish it from all the ordinary forms of inflammation, even though equally acute; and to connect it with that state of the nerves and blood-vessels which induce the non-inflammatory form of glaucomatous tension.

It is in the more acute cases of glaucomatous inflammation that punctures of the coats or chambers of the eye had been found beneficial before the introduction of the practice of Von Graefe. Such punctures, no doubt, may relieve tension to a certain extent, and for a certain time. They may give ease, and may cause the more intense symptoms to abate. Even without a puncture, the *acute inflammation* may subside, after running a certain course, and destroying sight. But it is most important to notice that, though a puncture may ward off for a time the destructive violence of the inflammation, a subacute excitement is likely to continue, relapses to occur, or, at any rate, the glaucomatous hardness of the globe to persist, under which eventual loss of sight is inevitable. It is not wise, therefore to rely on this expedient.

As long as any perception of light remains in cases of acute glaucoma, I would earnestly counsel an immediate recourse to iredectomy. No abatement of the more pressing symptoms from bleeding or any other remedy, no improvement of sight, *while tension continues*, is to be for a moment allowed to weigh against it. And even though all sensibility of the retina have apparently lapsed, I should not quite abandon the hope of rescuing some sight, provided the course had been very rapid, and the total extinction of sight very recent. At all events, an iridectomy would not be even then too late to hasten recovery from the the inflammatory symptoms, and to avert the after consequences of a hard and painful, as well as sightless, globe."

No. 1.—Diamond.

So many cases have been published of good recovery by iridectomy, from the otherwis fatal consequences of acute glaucoma, that I need not adduce others, even did time permit. One of the most interesting I have had is that of the coroner for a borough in Suffolk, a lawyer of middle age, who, some two years ago, had acute glaucoma successively in the two eyes in the course of a few months. For each he came to consult me for the first, after about four days; for the second, within the second day, each eye being

No. 3.—Agate.

at the time all but blind. I instantly in each case, performed iridectomy, and pursued no other treatment. The relief was immediate. The first eye regained an extended, though not a complete, field of vision, the nasal side remaining blind, while with the axis of the retina he could read No. 4 of Jaeger, (a small type*.) The second eye recovered perfect sight, and the amendment in both

No. 5.—Minion.

eyes continues, so that he has ever since uninterruptedly pursued all the duties of a very active professional life, and calls sometimes to express his gratitude—a gratitude I feel to be rather due, like that, I rejoice to say, of many hundred other sufferers in various countries, to Von Graefe.

No. 7.—Bourgeois.

The importance of the subject must be my

* We publish part of this article in "Jaeger" test types for the convenience of our readers.

apology, if I now point out some of the common fallacies by which precious time is lost.

1. If the disease be more or less acute, *i. e.* complicated with more or less inflammation, it is often treated by topical remedies, as hot or cold

No. 9.—Small Pica.

applications, leeches, blisters, sedatives, or by purges, mercury, colchicum, opium, with low diet. The sympathetic vomiting ushering in the most acute form is mistaken for a "bilious attack," and the essence of the disease quite overlooked.

No. 10.—Pica.

2. If it presents itself under one or other of its slower varieties, the particular cause is unrecognized, and the patient may be told, and the surgeon believe, that it is only "stomach," or "a little gout"—formulæ of speech

No. 12.—Great Primer.

which, however convenient, seem to me to have a good deal to answer for, even now-a-days. If it be true, as I know it to be, that no remedies given on any such

No. 13.—Double Small Pica.

loose notions can exert any salutary influence on the disease, even if the stomach be in fault, which is common, or the patient be really

No. 14.—2-Line English.

gouty, which is more rare, while the eye is gradually losing sight through a distention,

No. 15.—2-Line Great Primer.

which only a surgical proceeding can reduce, the sooner a more correct knowledge of the actual condition of the

No. 16.—Canon, Antique.

eye is obtained, the better

No. 18.—3-Line Condensed Antique.

for both parties.

3. Patients themselves are often alarmed by the idea of any operation, or they are afraid to take chloroform ; or being feeble or old, or desponding, an operation is thought to be "not worth while;" or they have a dread lest it should injure the other eye from sympathy. Thus, taking counsel of their fears, especially in chronic cases, where no immediate urgency exists and they suffer little pain, what they regard as the evil day, but what is really the day of relief, is put off, often till it is too late. I have seen this so repeatedly that I must allude to it, even at the risk of appearing tedious.

I shall not easily forget the case of a feeble, dyspeptic clergyman from Derbyshire, who called on me a fortnight since, so altered that I hardly recognized him. Two years ago, he was in a deplorable state of despondency from blindness, far advanced, from chronic glaucoma; and I had the greatest difficulty in inducing him to submit to iridectomy. He is now able to do his full duty, and is happy and cheerful.

I have alluded, in very general terms, to three principal forms of glaucomatous disease—the slow non-inflammatory, the subacute, and acute inflammatory forms. These offer infinite varieties, and are met with in various combinations, which it would be impossible to advert to in detail on the present occasion. But some of them may be specified.

There is an intermittent form, with perfect remissions, and if the attacks are rare, and moderate in degree and duration, they may do no structural damage to the eye during many years. Being excited by temporary causes, they may, in some measure, be guarded against; and it is only if they become frequent, and a continual source of disquietude and danger, that iridectomy becomes applicable. That most interesting phenomenon of iridizations, or rainbow-colors around a candle or light object, is very apt to occur in this form, as well as in the subacute variety. In simple glaucoma, it is uncommon.

There is a hemorrhagic form, one which I regard as of great and exceptional importance, and which is fortunately rare, since iridectomy is less certainly able to control it, or to save sight. Glaucomatous inflammation may supervene upon a hemorrhagic condition of the retina, with distressing pain, augmenting tension and decay of sight, and a relapse may occur again and again, after repeated relief following repeated iridectomy, the event being sometimes complete blindness, though some such eyes have been partially rescued. I could relate several interesting cases of this hemorrhagic form. Glaucomatous tension may also attend certain cases of iritis, whether that form formerly styled *aquo-capsulitis*, or *recurrent* attacks with *synechia*, and *choroidal affection*. In many of these I have found iridectomy of the utmost service ; but I can only refer to them now.

There are also the complications of glaucomatous disease with cataract; glaucomatous tension coming on in the earlier and later stages of cataract.

An accurate diagnosis is most important here, as the glaucoma has first to be dealt with by iridectomy, and the cataract reserved for a future operation, after the glaucomatous tension shall have long ceased. The glaucomatous element will not admit of delay ; the cataract will wait, indeed must; for to attempt to extract a cataract from an eye when in a glaucomatous state would entail great risk of destruction of sight from interocular hemorrhage. But I have, in several instances, dealt in succession with the two several diseases with most satisfactory results. Nevertheless, the complication is a very grave one, and the treatment tedious.

For the supposed dependence of glaucoma on

various blood affections, experience affords slight warranty; albuminuria, diabetes, are rare with it; gout and rheumatism far from common. It often occurs in persons of excellent constitution, though most frequent in those whose nervous powers are depressed. Its whole history points rather to its origin in certain states of the nerves supplying the blood-vessels of the eye; but the question is too abstract a one to be now entered upon.

I must now forego all reference to the operative procedure itself, for want of time; or I might offer some hints supplied by an extended trial of several methods. I by no means wish it to be imagined to be always simple and free from risks; but these may be avoided by care, and are only what every such remedy is exposed to.

It may be expected of me, however, not to pass over altogether in silence Mr. Hancock's operation, called by him division of the ciliary muscle; and applied as he informs us in the *Lancet* of last week, "with most success in keratitis, sloughing of the cornea, staphyloma, dense opacity of the cornea (in some cases of several years' duration), and in conical cornea; also, in certain forms of amaurosis, in acute and chronic glaucoma, and in posterior staphyloma and myopia"—a list comprising diseases so widely different from one another, as to suggest a doubt whether a common principle can govern their treatment by the same surgical proceeding.

The incision through the coats of the eye, thus styled division of the ciliary muscle, involves, I believe, the sclerotic coat, a very small portion of the whole ciliary muscle, the ciliary body of the choroid, with the vitreous humor. In many instances, it appears to have evacuated the aqueous humor, while the vitreous humor must always either escape at the moment, or have liberty to drain away for some time afterwards. If it be of the essence of the operation to divide the inner or circular fibres of the ciliary muscle (Heinrich Müller's), then a consideration of the anatomy of the parts would show, I think, that the aqueous chambers are likely to be opened. If the humors of the eye escape, tension is, of course, relieved; and if much vitreous humor be lost, it is conceivable that even permanent reduction of tension may result. Experience only can determine whether such an operation may suit certain forms of disease; the proceeding may possibly have advantages in certain cases, although the hypothesis on which it is grounded prove untenable. Meanwhile, it seems desirable that the cases in which it is said to have affected so much, and on the strength of which the profession is urged to adopt it, should be published in greater detail, and with that regard to scientific accuracy which recent advances in knowledge demand. Particularly is this to be wished for, when we are asked to abandon in favor of this incision in glaucoma, the operation of iridectomy, the admirable results of which have now been tested by a wide experience, and guaranteed by many men fully capable of arriving at a sound conclusion.

[The following is added in accordance with a wish expressed by the meeting at which the above paper was read.]

Note on the Operation of Irideetomy for Glaucoma.

The operation is best done when the patient lies on a sofa on his back, with the surgeon standing at his head, I prefer to use chloroform, though I have often operated without it. It should be given so as to render the patient completely passive; for the great delicacy of the operation requires perfect quietude of the eye, lest the steps should not be severally completed in the most perfect way. My own opinion undoubtedly is, that there is hardly any person to whom chloroform may not be safely administered; though it is true, some subjects demand more care in its exhibiton than others. The sickness may usually be avoided by taking care that no food be in the stomach at the time; and if it occur during the operation, the steps must be simply delayed while it lasts, not varied in any way. If the sickness is very straining, so as to distend the vessels of the head and face, I usually close the eye, and gently compress it by the fingers on the lid, during the efforts at vomiting. I have not seen any harm happen from such vomiting, when the incision has been properly made; not too extensive, and not too far back from the corneal margin.

I always keep open the lids by the wire speculum, which an assistant holds a little forwards if it tends to exert pressure on the globe. It is well for the surgeon to be able to use the right or left hand indifferently in making the incision, as he can then select the most convenient spot. I have always preferred to make the iridectomy nearly or quite upwards; because I believe this direction to be as good as a lateral one in reference to the visual field, and the upper lid then covers the gap in a way useful both optically and for appearance sake. It is, however, rather more easy, on the whole, to make the iridectomy to one side than upwards.

I make the incision in one of two methods, according to the size of the anterior chamber. When there is space enough, it is best to use the triangular lancet shaped blade, inclined at an angle on the flat, and which I believe is used generally abroad, as well as by Von Graefe. Having selected a place for the incision, I seize the conjunctiva with proper forceps immediately opposite, and thus fix the globe without making any pressure upon it, or pulling it from its bed. The lancet is then thrust in so as to enter the anterior chamber at its rim immediately in front of the attached border of the iris, and is carefully advanced towards the opposite side so as to form an opening of the required size; and if the opening cannot thus be made as large as is desired, it is enlarged at one angle on withdrawing the blade. When, however, the chamber is shallow, I prefer what I at first always used; namely, a narrow extraction knife, running its point along the rim of the chamber for the requisite extent, and making the counter-puncture much as in ordinary extraction.* Thus the instrument avoids the pupillary region and the lens. The operation is more difficult where the chamber is shallow. Whichever instrument be employed, it enters a little behind the apparent junction of the sclerotica and

* The same procedure has since been recommended by Froebelius, of St. Petersburg. (*A. f. O., VII.*, 2.) Ed.

cornea, in the sclerotica; and in entering the rim of the anterior chamber, it usually passes across the junction and through a very little of the corneal tissue just in front of the pillars of the iris.

As the instrument used in making the incision is withdrawn, the aqueous humor escapes; and it is well to let it do so gradually, and to keep the point of the instrument towards the cornea rather than towards the lens. The iris may be now found either to remain in the chamber or to prolapse. If the former, the small* slightly curved iris forceps are to be introduced (closed) into the chamber, and made to seize the iris opposite the middle of the incision, about midway between its pupillary and outer border. The iris is then brought outside the chamber and divided with small scissors, on one side of the forceps, from the pupillary to the ciliary border, the forceps pulling it gently at the same time, so as to insure this complete division of it. The end held by the forceps is then torn from the ciliary attachment as far as the angle of the incision, and even dragged upon a little, so as to detach it beyond the angle, and then divided with the scissors quite close to the angle. The cut end then retreats within the chamber. The opposite side of the prolapsed part is then seized and dealt with exactly in the same manner. No iris should be left in the angle of the incision, lest the healing process be imperfect, and subsequent irritation occur.

If the iris at once prolapse on the completion of the incision (it is often bulged by aqueous humor of the posterior chamber), the forceps need not be introduced within the incision, but may seize it outside. The less any instrument enters the anterior chamber the better, for fear of damage to the lens.

If any blood flow into the anterior chamber during the operation, it is as well to allow it to escape before it coagulates. This is best done by inserting a fine scoop within the lips of the incision (not into the chamber), and at the same time by making, if requisite, slight pressure on the eye by the forceps which holds it. The cornea should not be pressed on, lest the lens receive injury; and, rather than run the slightest risk, the blood may be allowed to remain, as it is very soon dissolved by the aqueous humor, and flows out or is absorbed.

The operation just described insures the excision of a complete segment of the iris, from the pupillary to ciliary margin, of a width determined by the size of the incision, and which may be usually about a sixth or a seventh of the whole circle.

After the operation, little is usually required beyond seclusion of the eye from light while it remains sensitive, keeping it cool by a wet rag as long as may be agreeable to the patient, together with ordinary attention to the general functions.

In all but a few cases, the globe tension remains permanently lessened afterwards. In some, it returns more or less during a few days, but again subsides as the wound fully heals. In some, where it has long existed, or been extreme, it is not entirely relieved, but only much lessened; and here an additional iridectomy may or may not be required, according to the indications afforded by the state of vision. If this seems to be recovering, no further interference will be necessary; and, indeed, if the iridectomy have been properly performed in the first instance, it will very rarely have to be repeated. In at least three instances, I have known such a supplementary operation completely efficacious in reducing tension to the natural standard, when, from one cause or another, the effect of the original iridectomy had proved insufficient."*

* The points of the forceps, when closed, should form a perfectly smooth end, so as not to scratch the lens, or catch in the iris, on sliding over it.

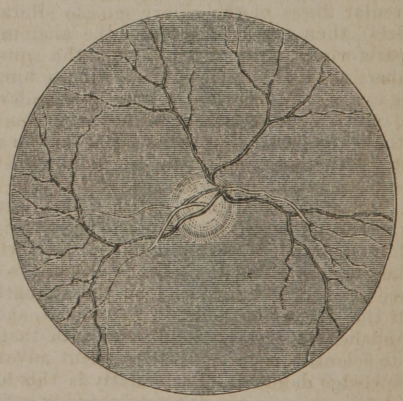
The Ophthalmoscopic Appearances in Glaucoma.

In a paper on glaucoma, by Mr. Hulke, published in the "Medico-Chirurgical Transactions," Vol. xliii., he has carefully noted the appearance of the eye during life, and there are several records of minute dissections, performed during the early stages of the disease, which are very valuable, since opportunities for such investigations must become more rare as a sure method of treating the affection has been discovered.

Mr. Hulke's general description of acute and chronic glaucoma does not differ in any respect from those which we have already given. But he calls particular attention to the flattening of the cornea, the result as has been shown experimentally of excessive distention.

Respecting the ophthalmoscopic signs, excavation of the optic nerve-entrance and pulsation of the central vessels, are characteristic signs with the veins abruptly bent and displaced laterally at its margin, which is seen in Fig. which has been carefully copied from reduced copies of the plates of Dr. Edward Jaeger.

Fig. 6.



"The abruptness of the excavation and its frequent extensions in a latent direction, undermining the sclero-choroidal foramen, so different in their features from the gently sloping hollow of the simply wasted nerve-entrance are unmistakable effects of over pressure. No traction from behind in the direction of the nerve trunk, as has been supposed

to occur, is competent to explain these appearances; they are the combined effects of excessive intra-ocular pressure and wasting of the nerve tissue reduced by it."

It might be well here to state that a young beginner in looking at a hollowed optic disc for the first time will with difficulty persuade himself that he is not looking at the outer surface of a sphere instead of into a cup, so deceptively does the hollow simulate a projection. This illusion results from a particular disposition of light and shade. A slight side movement of the object lens or speculum, by shifting the spot of most intense illumination, will dispel the illusion.

Frequently there are seen several small dotted hemorrhage in the retina and filmy clots in the vitreous humor. The excavation is indicated by a bluish-grey color of the periphery of the optic disc, and a peculiar arrangement of its vessels. When slight these undergo a sudden diminution at the margin; when the hollow is deep they are abruptly bent, or their continuity apparently interrupted at the margin. In extreme excavation the bottom of the hollow lies outside the level of the choroidal foramen. He has dissected an eye-ball where the lamina cribrosa itself was pushed outwards. The retinal hemorrhages come from ruptured capillaries which have become varicose and saculated from over-distension. The vitreous humor, both in acute and chronic glaucoma continues for a long time much firmer than natural. He has been much struck with this in several eyes which he has dissected at an early period of the disease, and has verified the same fact in the living eye, by puncturing the sclerotic, and endeavoring in vain to squeeze out some of the vitreous humor. In old cases where the lens had become brown the writer found the vitreous diffluent. Mr. HULKE, in a recent dissection of acute glaucoma, found a thin stratum of yellow serum between the hyaloid and the membrana limitans of the retina. In a very typical case, he observed also on dissection the hollow of a large sclerotic staphyloma, wholly filled with very firm vitreous humor, in no way differing from the remainder. He agrees with GRAEFE that acute glaucoma is a *serous chloroditis*, and the whole pathology may be summed up thus: In the first instance, the choroid circulation gets deranged, hypertrophy of the vitreous humor ensues by endosmosis, as a consequence, and the retina and optic-nerve entrance is acted on secondarily by pressure.

Anæmia of the Optic Disc.

Simple anæmia of the optic disc shows itself by a corresponding pallor, the nerve-tissue retaining its transparency so that the large vessels continue to be visible at some distance from the surface of the disc. The whiteness of a simply anæmic optic disc is dull and not glistening as the tendinous whiteness of atrophy. A rare cause of anæmia is the obstruction of the retinal artery by an embolus. The supply of blood to the optic disc and retina is suddenly cut off. The branches of the artery are empty and contracted, they contain but little blood and this only at intervals, intermediate portions being empty. The extremity of the nerve is blanched. A case of this kind has been recorded by V. GRAEFE.*

Atrophy of the Optic Disc and Retina.

This, as we have stated under the head of anæmia, has a peculiar tendinous or pearly whiteness, in consequence of this whiteness the atrophied optic disc is very conspicuous. Its outlines at first sharp, subsequently lose their distinctness and become ragged; and its surface becomes depressed. The following case is reported by HULKE:

"M. A. H., æt. 24 in July, 1858, whilst standing in the sun with her head uncovered, was suddenly seized with violent pains in the temples. On the second or third day after this, the pain extended to her neck and shoulders, she then fell from her chair in an epileptic fit. This was followed by hemiplegia of the left side, diplopia and rapid failure of vision, so that fourteen days afterwards when she came under my notice, the retinæ were quite insensible to light. At this time I could detect nothing abnormal in the fundus, but on a second examination made December 16, 1859, I found the retinal vessels very much diminished in calibre, and the optic nerve-entrance was pearly white and sunken."

Remarks upon the Operation of Iridectomy for the cure of Glaucoma.

The operation described with so much care by Dr. BOWMAN, differs from artificial pupil in the larger incision of the cornea, and also more iris is to be taken away. GRAEFE says that there is a direct relation between the amount of iris lost and the effect on the disease, but that not so much as a third, or even a fourth, need be excised. He operates with a lance-shaped knife introduced half a line behind the junction of the cornea and sclerotica, and directed so that its point may pass into the anterior chamber exactly at the point of union. To prevent hemorrhage he recommends slight

* V. GRAEFE, Ueber Embolie der Arteria centralis retinæ als Ursache plötzlicher Erblindung. Archiv. F. Ophth. Bd. v. Abth. 1, S. 136.

compression for half an hour, or an hour, and to be gradually relaxed.

The general condition of the eye makes the proceeding less easy than establishing a false pupil. The strip of iris is to be excised to the very circumference. The cornea, therefore, must be cut through at the extreme margin or rather through the sclerotic and cornea where the cornea underlies the sclerotic.

As the iris bulges, being sometimes in actual contact with the cornea, it is apt to be penetrated; indeed, it is sure to be, without great care. With such an accident, the lens, which is almost always thrust forward, will, in all probability be wounded, and bleeding will be apt to obscure the other steps of the operation. We must enter the anterior chamber and take hold of the iris on its anterior face, when, by the evacuation of the aqueous humor, the iris falls forward; if the iris is adherent the case is not a suitable one for the operation.

The instruments required are, a lancet or lancet-shaped knife, a pair of forceps or blunt hook, and a curved pair of scissors. The sharp iris hook of TYRELL'S is so apt to wound the capsul of the lens that it had better not be employed. In cutting off the iris after drawing it out, cut off half the flap and then draw it upward and cut off the other portion. This is Arlt's method and allows it to be cut up to the margin of the corneal wound.

In some instances iridectomy has been applied where there was no glaucoma, and to the manifest injury of the patient. I would therefore advise caution and a thorough study of the diagnostic signs so ably given by Dr. BOWMAN, before resorting to an operation, in the modern phrase, in anticipation of the disease as cases of acute inflammation of the sclerotic, implicating to a more or less degree the iris and cornea, and attended with severe neuralgia and impairment of vision resemble glaucoma, but such cases will yield to judicious treatment without any operation.

Other operations have been devised from glaucoma, and I will therefore give an abstract in the author's own words of each of them. The first is the operation of Mr. HANCOCK, an account of which was first published in the *London Lancet*, February 11, 1860. He says:

"I believe that glaucoma, whether acute or chronic, is essentially a disease of the blood and blood-vessels, and that the effusion or infusion, as may be described, is the result of this condition, which, if not arrested, sooner or later, destroys sight."

He observed that, "in acute glaucoma, the eyeball is constricted, and marked by a circular depression at the point corresponding to the ciliary muscle, whilst the vessels round this point are gorged to a great degree. The eyeball is elongated in its antero-posterior diameter, and the cornea lessened in all its diameters, and rendered more conical than natural: whilst, when the patient turns his eyeball sideways, irregular bulging of the sclerotica (staphyloma) is exposed to view."

"All these considerations," he continues, "led me to suspect that the ophthalmoscopic and pathological appearances of the blood-vessels were greatly enhanced by, if not, in some instances, entirely due to, the obstruction of the circulation, caused by the undue and excessive construction exerted on them by the spasmodic, or extreme contraction of the ciliary muscle, analogous to the spasm so often observed in the muscular fibres of the urethra, as well as in the sphincter ani muscle in certain affections of those parts."

To obviate the injurious effects of this spasm, he determined to divide the ciliary muscle. He says that the practice has been attended with the best results.

His mode of operating is thus given:—"I introduce a BEER'S cataract knife at the outer and lower margin of the cornea, where it joins the sclerotica. The point of the knife is pushed obliquely backward and downward until the fibres of the sclerotica are divided obliquely for rather more than one-eighth of an inch; by this incision the ciliary muscle is divided, whilst the accumulated fluid flows by the edge of the knife."

The alleged advantages are:—1, It obviates the objections to iridectomy; 2, It relieves pain by the removal of the constriction of the eyeball, and the consequent pressure upon nerves, from the undue contraction of the ciliary muscle; 3, By it the accumulation of fluid is evacuated, and the impediment to the circulation through the blood-vessels being got rid of, they are placed in a favorable condition to recover their normal state; and a probability of a recurrence of the effusion is greatly diminished; 4, By the situation and oblique direction of the incision, a free drainage of the fluid is provided for; 5, The iris is but slightly wounded, and the pupil is preserved of its original size and shape, and in its normal situation; 6, The danger of wounding the lens is avoided.

Mr. HANCOCK is opposed by every other observer when he says that the cornea becomes conical in glaucoma—flattening is one of the most characteristic symptoms.

It is not probable, I think, that such a muscle

as the ciliary could contract with sufficient force to groove the hard and stony eyeball of glaucoma; still less likely is it that such spasm could be continuous.

I ought to mention that Mr. HULKE says, he has several times verified by dissection the co-existence of a hard painful glaucomatous state of the eyeball, with advanced atrophy and fatty degeneration of the muscle.

Mr. SOLOMON has devised a method of dividing the ciliary muscle in glaucoma, which he terms "intra-ocular myotomy." It is performed "by entering a BEER'S cataract knife at the corneo-sclerotic union, and then pushing it through the pillars of the iris into the muscle; the flat surface of the blade being opposed on the one side to the sclerotic, and on the other to the rim of the lens." He limits the incision in the muscle to two lines—one-sixth of an inch. "The intra-ocular incision cuts across a bundle of the radial fibres of the ciliary muscle, branches of the ciliary nerves of the third pair, and perhaps of the fifth."

The anterior chamber is generally penetrated, and the posterior put in communication with the wound. By this operation, "the circulation in the choroid is regulated, and the stony hardness of the eyeball in glaucoma, and the extreme tension in cases of acute choroido-iritis, sub-acute syphilitic iritis, with recent pupillary occlusion, hydrophthalmia, with the ciliary neurosis which attends these disorders, are either cured or much relieved."

He has performed the operation successfully in cases of acute and chronic glaucoma, choroiditis, conical cornea, myopia, presbyopia, asthenopia, &c., &c. "*Medical Times and Gazette*," May 19th, 1861.

I conclude this chapter with Mr. NUNNELEY'S operation. His papers are contained in the "*Lancet*" for January 19th and 26th, 1861.

He believes, from the report and from experience, that cures more or less complete have followed the performance of iridectomy, but considers the reasoning by which such results are attempted to be explained, as unsatisfactory. "When it was first proclaimed that the removal of a large portion—the more the better—of what had hitherto been supposed to be an important, nay, essential tissue for satisfactory vision, and the injury of which in a much less degree would, in the great majority of cases, render a sound eye useless, would be found to be a perfect cure for an eye already almost hopelessly diseased, it appeared so astounding that, like many others, I waited before doing it until the reports of some of those who had more faith than I had, gave the result as so uniformly successful, that doubt gave way before recorded facts, and though unconvinced by the reasoning, longer resistance to them appeared like obstinacy."

He thinks that "all that iridectomy accomplishes in the cure of acute glaucoma and glaucomatous diseases is in the greater degree and more permanent manner in which it affords relief to intra-ocular pressure than paracentesis, as performed previous to its introduction, did." The removal of the iris he considers as an evil to be avoided; "The good accompanying its removal does not, in my judgment, result from the iris itself, but from allowing a greater yielding of the eyeball—in all probability owing to a greater division of its curve being made when a large portion of the iris is taken away, than when none of it is removed—and thus permanently lessening its tension, as well as affording a longer continued drain of the aqueous humor." If this be the case, it is desirable to operate effectually for the relief of tension without injuring the iris, as he demurs to the idea that removal of part of this muscle diminishes the secretion of the aqueous humor. He continues,—"Observing that the eyeball is often distended to the utmost limit which the comparatively unyielding sclerotica and cornea will allow, and that the pain and acutely distressing symptoms in the ball and about the orbit commonly occur in proportion to the rapidity with which the distension takes place, whether the disease be glaucoma, iritis, or choroido-iritis,—and knowing that the most unyielding portion of the globe is the point of junction of the sclerotic, cornea, iris and ciliary muscle, which may not unfrequently, in very decided cases of hydrophthalmia, be observed as a depressed ring between the bulging sclerotic and cornea,—it occurred to me that division of this part would afford the desired relief, and that not improbably the good gained in Von Graefe's operation in reality depends upon the removal of the resistance of this part, and not upon the ablation of the iris."

The operation which, in accordance with these views, he devised, he describes as follows:—

The manner in which I have operated is to puncture the sclerotic coat with the point of a sharp thin knife—a small cataract knife, or very narrow, short bistoury answers very well—not less than one-eighth of an inch behind its junction with the cornea, and carry it on to about the same extent through the cornea, making altogether an incision about one-third of an inch long. Care must be taken to pass the knife sufficiently deep

to completely divide those textures, and yet not so deep as to touch the lens, which I once did, owing to the patient starting at the moment the incision was made. Care also must be taken not to make the incision too long. A larger incision in the sclerotic, besides unnecessarily wounding important tissues, is useless, and if carried too far towards the centre of the cornea, though allowing this afterwards to yield more, is bad, for it may allow the lens to be displaced into the aqueous chamber; and if the iris should adhere to the whole extent of the corneal section, as it is likely to do, particularly if a portion of its whole breadth has been removed, not only will there be dragging of it, but the section becomes opaque, and hence the field of vision is lessened. In making the section, if the point of the knife has been well kept in, the outer margin of the iris will be divided. Sometimes the iris bulges through the section. I have tried the effect of simply leaving the prolapsed iris in the wound, of cutting it off, and also of pulling out a larger portion, and cutting off a strip through the entire width. In this latter plan the operation more nearly assimilates with Von Graefe's iridectomy, only that the section through the yielding tissues is made directly across their junction, instead of into or parallel with it, whereby a greater expansion in it is allowed, and not nearly so much of the iris is removed. If none of the iris be cut off or tied, the pupil usually recovers its circular form; if some be excised, it remains oval and attached to the corneal cicatrix, in proportion to the size of the piece removed, but in a much less degree than would be *a priori* anticipated. The degree of deformity is very slight indeed."

As to the situation of the incision, Mr. Nunneley prefers "the centre of the lower corneal curvature" as most generally convenient.

At the time of writing, he had performed the operation in about twenty cases, and prefers it to that of Von Graefe. The wood cut given in this number should have been in number for April 2d, page 203, it shows the excavation of the optic nerve-entrance in the ophthalmoscopic appearance of Glaucoma.

The Accommodation of the Eye.

The human eye is one of the most beautiful as well as one of the most useful organs which man possesses; with it he can see the smallest insect or the loftiest mountain; at one moment the circulation in the frog's foot, or at a glance take in a vast expanse of scenery. Is there no change in the eye in viewing these different objects? Yes, there is. The term we use to express the power which the normal human eye possesses of adjusting itself imperceptibly and unconsciously to different distances is "accommodation."

Various opinions have been expressed and numerous experiments have been made to determine in what the changes of accommodation of the eye consist. The cornea, from its great importance in accurate vision was supposed to have undergone some alteration during accommodation, but Helmholtz experiment put this theory to rest by his ophthalmometer in showing that there is no alteration in the curvature of the cornea during accommodation.

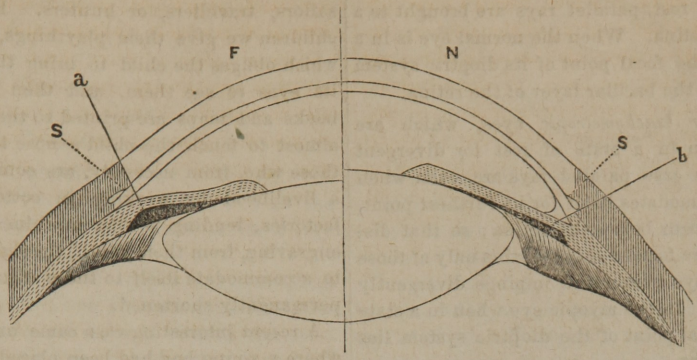
Arlt supposed that the muscles of the eyeball played an important part in bringing about the proper adjustment of the eye in conjunction with the ciliary muscle. He states that "The accommodation or adjustment of the eye for near objects is brought about by the elongation of the eyeball in the optic axis, by the pushing back of the posterior wall of the eyeball, by the retrogression of the yellow spot and its vicinity. The organs causing this are on the one hand, the straight and oblique muscles of the eye; on the other, the ciliary muscle—they being simultaneously placed in a higher state of tension."*

It has been proven by a case of Von Graefe's that the action of the external muscles of the eyeball is not necessary in the act of accommodation for near objects, for in his case all the recti and obliqui muscles of the eyes were paralyzed, so that the eyes were completely immovable, and yet the power of accommodation was perfect.

"It has at length, however, been definitely settled, chiefly by the experiments of Cramer and Helmholtz (conducted independently of each other), that the necessary change in the refraction of the eye during accommodation is due to an alteration in the form of the crystalline lens. Helmholtz found by means of his ophthalmometer, that the lens did not change its position during accommodation for near objects, but this was brought about by a change in the curvature of the anterior and posterior surfaces of the lens, which become more convex (the lens itself thicker from before backwards), so that the lens acquires a higher power of refraction, and consequently a less focal distance, by which means rays from even very near objects are brought to a focus upon the retina. He found, with the ophthalmometer, that the eye undergoes the following changes during accommodation for near objects: 1. The pupil diminishes in size. 2. The pupillary edge of the iris moves forward. 3. The peripheral portion of

* Arlt, Vol. III., p. 207.

Fig. 7.



iris moves backwards. 4. The anterior surface of the lens becomes more convex (arched), and its vertex moves forward. 5. The posterior surface of the lens also becomes slightly more arched, but does not perceptibly change its position. The lens therefore becomes thicker in the centre."†

As the volume of the lens must remain the same, he thinks that we may moreover, assume that the transverse diameter of the lens becomes diminished. He finds, from calculation, that these changes in the lens are quite sufficient for all accommodative purposes.

Fig. 7 Illustrates the changes which the eye undergoes during accommodation. The anterior portion of the eye is divided into two equal parts. The one half F, shows the position of the parts when the eye is adjusted for distance; the other, N, when it is accommodated for near objects. When the eye is in a state of rest the iris forms a curve (a); in the vicinity of Schlemm's canal (s); when accommodated for near objects the fibres of the iris become contracted, the periphery of the iris straightened (b); and the anterior chamber lengthened, thus making up for its loss in depth, through the advance of the anterior surface of the lens. The question was set at rest by a case which occurred in Prof. Von Graefe's clinique, in 1859. The case is shortly this: Whilst Prof. Von Graefe was abscising a prolapse of the iris, the patient made a sudden violent movement with his head which the assistant could not check; the iris was somewhat dragged, and a dialysis occurred at the opposite side. The portion of iris still lying between the lips of the wound was drawn gradually out until the dialysis was complete. The whole iris was thus removed. The slight effusion of blood soon disappeared from the anterior chamber. Ten days after the operation the cornea had also regained its transparency.

† Helmholtz—Wells.

The state of vision in this eye was as perfect as the other normal eye. He could count fingers at one hundred and fifty feet, and read No. 1 of Jägers, *i. e.* the smallest print, at eight inches. The power of accommodation was most accurately and severely tested, and it was found in spite of the total absence of the iris, his power of accommodation was quite normal.

The Range of Accommodation.

We can test the range of accommodation by means of Von Graefe's wire optometor which consists of a small square steel frame, across which a number of very fine parallel, vertical wires are stretched. This frame is attached to a brass rod upon which it is movable, the rod being graduated in inches and feet. One end of the rod is placed against the forehead of the person to be examined, and then the frame is moved to the nearest point at which the individual wires still look clearly and sharply defined; the distance of this point from the eye is read off from the graduated scale, and put down at the *near point.* The frame is then removed to the greatest distance at which the individual wires still appear sharply defined, and this is noted as the *far point;* the distance between the latter and the near point is the territory or *range of accommodation.* This instrument requires some exactitude and intelligence on the part of the patient.

Mr. Wells finds it generally more practical (particularly with hospital patients) to try them with the test types. If, whilst they are reading No. 1, we move the type a few times alternately nearer and further from the eye, we can readily ascertain with exactitude the nearest and furthest point of distinct vision.

Donders classifies eyes according to the furthest point of distinct vision, and distinguishes three categories.

1. *Normal or emmetropic* eyes, in which, when the eye is at rest, parallel rays are brought to a focus on the retina. When the normal eye is in a state of rest, the focal point of its dioptric system is situated on the bacillar layer of the retina.

2. *Myopicor brachymetropic* eyes, which are adjusted, when in a state of rest for divergent rays. In this case parallel rays are, even when the eye accommodates itself for its furthest point, brought to a focus before the retina; so that distinct images are formed on the retina only of those objects, the rays from which impinge divergently upon the eye. In the myopic eye when in a state of rest, the focal point of the dioptric system lies before the retina.

3. *Hypermetropic* eyes are adjusted for convergent rays. In this case parallel rays are brought to a focus behind the retina when the eye is at rest; for in hypermetropic eyes the focal point of the dioptric system lies, when the eye is in a state of rest, behind the bacillar layer of the retina

When the distance at which an ordinary sized type can be read comfortably, is much less than *twelve inches*, the vision is said to be myopic, when on the contrary, it is much greater, vision is said to be presbyopic. *Twenty feet* is the distance arbitrarily assumed as that which the rays of light from an object are about parallel. The limits within which the eye can see perfectly distinctly at different distances, in other words the limits of perfect vision may be put down at below *nine* and *fifteen* inches, below *nine* or above *fifteen* inches vision may be still distinct, but not perfect.

The surgeon should have a series of concave glasses with which to test the sight when complaint is made that objects at some distance cannot be seen distinctly, as in myopia or shortsightedness; and a series of convex glasses for the same purposes, when the complaint is that in reading or sewing, the sight is indistinct, unless the book or seam be held at arm's length, as in presbyopia or farsightedness.

Myopia or Short-Sightedness.

In my introductory remarks I stated the fact that a large proportion of defective vision was owing to myopia or "short sight" and this defect, I am satisfied, is on the increase. Owing to our exercising our eyes upon small objects as the reading of small print newspapers, the constant use of the eyes on fine needle-work, bending the head forward over the heated gas burner, and in many ways causing a determination of blood to the head. This is a defect that is almost peculiar to those who have lived all their lives in large cities, for it is rare in the country or among sailors, travellers, or hunters. Even with our children we give them playthings, as beads, &c., which obliges the child to bring the objects near its eyes to see them, and then at school the books and maps are printed so that the book has almost to touch the child's nose to be read. In those who, from necessity, are compelled to gain a livelihood by working in cotton or woollen factories, tending sewing machines, lace sewing, engraving, from their youth, the sight being forced to accommodate itself to these distances becomes permanently shortened.

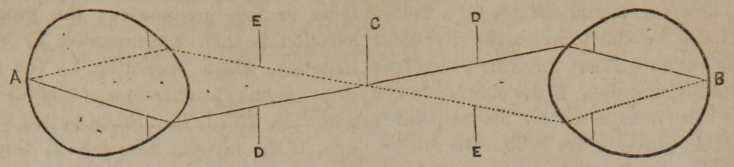
A recent interesting case came under my notice where a young boy had been placed with a printer as his apprentice, where being compelled to exercise his sight all day upon the minute type, it caused decided "short-sight" arising from the too frequent and continued adjustment of vision. By exercising his eyes every day on distant objects, the free use of fresh water in which was a small portion of brandy, and the use of moderately strong concave glasses facilitated his reading and writing, and prevented him from giving up his employment. By this treatment if early and perseveringly employed, especially if the subject is still young, we sometimes make a complete cure. There is no doubt but that myopia is increased during youth if objects are brought too near, and will eventually reach a high degree if the patient neglects to relieve his sight by looking at large and distant objects, especially too, if the head is bent forward. One of the most valuable hygienic means, is repose of the eyes one or two months, and a change from the city to the country.

In a troublesome and tedious case of *amblyopia* produced in a myopic patient, by too assiduous use of the pen, the head being heated by the gas, the cure was effected by some mild local remedies, and the entire rest of the eyes, the gentleman being sent, at my suggestion, on a business tour in the western country.

Spectacles should be avoided as long as possible, and we should recommend such numbers as will render objects more clear without lessening them or bringing them nearer. In school girls, who suffer from defective view or near-sightedness, their lessons should be learned in the day time with the book fixed so that they cannot bring it too close to the eye.

Several instances have come to my notice where girls have become decidedly myopic from studying by a very feeble light; and one instance, by the light of the moon. Teaching children early to read and write is another cause, more especially, if the paper or book is brought as close as the

Fig. 8.



child wants it; it should be kept as far from the eyes as the child can distinctly see it, and as the eyes improve, increase the distance in a very gradual manner.

Having thus spoken of *myopia* in general, and its treatment, we will now enter more methodically upon the subject, and we will employ the most recent works* upon the subject for the benefit of our readers. According to Dixon there is no external appearances in the eyeball itself, by which this peculiarity can be detected, the popular belief that it depends upon an excessive convexity of the cornea, but this is disproved by a careful examination of a few short-sighted persons. Indeed one has but to notice the nearly flat cornea of the short-sighted fish and the convex cornea of the far-seeing bird of prey, to be convinced that other parts of the eye must be chiefly concerned in the condition termed myopia.

If a patient can see small objects only by bringing them very close to the eye, and yet is not helped by concave glasses, a careful scrutiny of the crystalline lens should be made to determine whether a very slight amount of opacity may not exist in that structure. In myopia Wells states that the refracting power of the eye is increased, or the optic axis too long, so that parallel rays (emanating from distant objects), or even not sufficiently divergent rays, are brought to a focus before the retina; circles of dispersion are formed upon the latter, and in consequence of this, the object does not appear sharply defined but indistinct, and as if it were surrounded by a halo.

Lengthening of the eyeball (as, for instance, in sclerotico-choroiditis posterior) is also often met with as a cause of short-sight. Von Græfe, indeed lays it down as a general rule, that when the far point lies nearer than 3″ from the eye (the myopia being greater than one-fifth), we may almost with certainty diagnose the presence of this affection. Wells has sometimes seen it in cases where the far point lay at 10″ to 12″ from the eye, and we should therefore invariably examine all short-sighted persons with the ophthalmoscope, for this disease is always a dangerous complication.

Myopia and amblyopia (weak sight) frequently coexist. They may easily be distinguished, for although weak-sighted persons hold small objects near in order to see them, they cannot, like the short-sighted, distinguish very small objects. Concave glasses do not improve their vision for distant objects. If the patient is amblyopic and can see No. 2 of Jaeger at 3″, he ought to be able to see print double the size at twice the distance of the first; for the retinal images increase in proportion to the size of the print. "A person suffering from a simple myopia should, with the proper concave lens, be able to read the same print at the same distance as the normal eye (*i. e.* No. 18, and words of No. 16 of Jaeger at a distance of twenty feet). If, however, with the most carefully selected glasses, he can only read No. 20 at that distance, he is also amblyopic. The less the concave glasses correct the greater is the degree of the coexisting amblyopia and *vice versa*."

Ophthalmoscopic Diagnosis of Myopia.

"1. If we examine the myopic eye in the erect image (merely with the ophthalmoscope without any convex lens before it) we are at once struck with the fact that we can see the fundus at some distance from the eye. If we regard one of the retinal vessels or the optic disc and move our head to one side, we notice that the image moves *in the contrary* direction; if we move to the right it moves to the left, and *vice versa*, so that we get a reverse image of the fundus."

Fig. 8, from Wells, will at once explain the reason of this. Let *a* be the short-sighted eye (myopia $= \frac{1}{6}$), and *b* the eye of the observer; *a* being in a state of rest, is adjusted for its far point (*c*), which lies 6″ before the eye. The rays from the fundus of *a*, therefore, meet at *c*, and crossing there fall in a divergent direction upon the observer's eye. If the latter be myopic (accommodated for divergent rays when his eye is in a state of rest), they will be united upon his retina (*b*) without the aid of and correcting lens behind the ophthalmoscope. If the observer's eye is normal he will (if adjusted for his far point) require a suitable convex glass behind the

* On long, short, and weak sight and their treatment by the scientific use of spectacles: By J. Soelberg Wells, London: John Churchill, 1862. Practical Study of Diseases of the Eye: By James Dixon. Second edition, London, 1859.

mirror, in order to render the divergent rays parallel. If he, however, accommodates for a nearer point, he will also be able to unite the divergent rays upon his retina without any correcting lens behind the ophthalmoscope. If the observer's eye is normal, he will (if adjusted for his far point*) require a suitable convex glass behind the mirror, in order to render the divergent rays parallel. If he, however, accommodates for a nearer point,† he will also be able to unite the divergent rays upon his retina without any correcting lens. The image of the observed eye will be seen (from this considerable distance) reversed because, as the rays from it cross at *c*, the upper ray *e* becomes the lower ray (after they have crossed), and the lower ray *d* becomes the upper.

"In examining a myopic eye in the erect image, we must place a concave lens behind the mirror, in order to obtain a distinct image of the fundus; the greater the myopia the stronger must this concave glass be, and the nearer must we ourselves approach to the eye. The field of vision will appear smaller, and the image nearer the eye of the observer than in the normal eye. The image is less bright in color, and less illuminated, but apparently larger; for we cannot, as in the normal eye (the size of the pupil being equal) overlook the whole optic disc at a glance, but only a portion of it.

It is of great consequence (as Donders strongly urges) accurately to determine the amount of the myopia, so that we may hereafter be able at once to judge whether it has remained stationary or has progressed. In the most favorable cases, the myopia remains stationary at the adult age; later in life it may even decrease somewhat, but generally this is not the case; and the popular idea that myopia decreases in old age is erroneous. This error is due to the fact that it was thought possible to determine the degree of myopia by the position of the near point, and partly also by the fact that short-sighted persons can see better at a distance when they get older, on account of the increasing diminution in the size of the pupil. There is nothing to be feared from a slight stationary myopia. Far different is it, however, if it be progressive; for then it is always a source of danger to the eye. Upon this important point let me give the following extract from Donders:

"'During youth, every myopia is perhaps more or less progressive; the progress of the affection is then accompanied by symptoms of irritation, which, according to Von Græfe, may even assume the character of sclerotico-choroiditis posterior. This is the critical period for the myopic eye; if the myopia does not at the same time increase to too great an extent, it may remain stationary, or at a more advanced age even decrease; if it, however, becomes greatly developed, we shall find it almost impossible hereafter to arrest its progress. At this stage we must therefore avoid everything that may cause determination of blood to the eye, and thereby tend to increase not all the sclerotico-choroiditis, but also the tension within the eye. Among these causes we must include particularly working with the head bent forwards. I cannot lay too much stress upon this. Every progressing myopia is threatening to the eye, If it remains progressive, the eye will soon become less and less usable (troublesome symptoms at the same time showing themselves), and not unfrequently vision is irrevocably lost at the age of 50 or 60 (if not even sooner), through detachment of the retina, extravasation, or atrophy, and degeneration of the yellow spot.'"*

We often meet with very slight cases of myopia; so slight, indeed, that the persons are not aware that they are at all short-sighted. If we, however, tell them to look at a distant object, a very slight concave glass of perhaps 60″ or 50″ focus improves their sight considerably. There is, however, another form of "myopia in distans," which was first described by Von Græfe, and which appears to depend upon a peculiar spasm of the ciliary muscle during the attempt of relaxation in adjusting the eye for distant objects."

Concave glasses, for short-sighted persons, are designated by numbers in this country. The plan does not seem to have been framed on any principle, and the numbers used by different opticians are not the same. No. 1 has a very slight degree of concavity. Those numbers most in use are from No. 3 to No. 8. Those above No. 10, are called high numbers, but some require as high as No. 20. The French and German scale begins with 72 inches for concave, and 96 inches for convex glasses. According to this scale, the smaller the number, the higher the power.†

* The furthest point of distinct vision in the normal eye, is at an infinite distance (parallel rays). Twenty feet is the arbitrarily assumed distance at which the rays of light ar about parallel.

† In normal eyes the nearest point of distinct vision lies at about three and a half to four inches from the eye.

* Von Græfe's Archiv. vol. vi., 2, 220.

† For further information upon this and kindred subjects, not treated, see "Jones on Defects of Sight, &c.," edited by the Author. Philadelphia: 1859.

Myopia in Distans.

"Von Græfe's attention was first particularly attracted to this affection by the following very interesting case:

"'A gardener (about 30 years of age), was able to read the smallest print from 4″—18″, medium type up to 2′, the largest sized print up to $2\frac{3}{4}$′, and yet he could only distinguish the vague outline of the windows of a house fifty yards off, not even being able to recognize their division into panes; he was likewise not able to say whether or not there was any writing on a signboard at the same distance (fifty yards). A short-sighted individual, who could only read the largest print within 2′, on being placed beside him, for the sake of comparison, had a far more distinct impression of objects at the same distance, and could, without nipping his eyelids together, even distinguish the first letters (1′ in height) of the inscription on the signboard. A third myop, who could only read the largest print up to $1\frac{1}{2}$′, had yet far more distinct impressions than the first-named patient, and an excessively short-sighted individual, (suffering from sclerotico-choroiditis posterior), who could only read the smallest print up to 4″, the largest up to 6″, saw distant objects about the same as the first individual, who only required concave 30 for seeing well at a distance, whereas the very short-sighted person required 3—$2\frac{1}{2}$. The first-named patient therefore appeared to me to be a capital example of myopia in distans, and well fitted for the accurate determination of the existing conditions.'"

When Von Græfe tried him with an object, (a portrait), gradually removing it further from the eye, there was not, as in common cases of myopia, a gradual diminution of distinctness; but at a certain tolerably constant point (considerably beyond the alleged far point) the object suddenly appeared to become wider and more indistinct, so that the patient could still distinguish the features up to about 6′, but could not at 10′ distance even discern the outlines of the picture.

Although he could see distant objects clearly when a concave glass (No. 30) was placed before his eye, yet a certain time was necessary for this, and he felt that the tension of his eye changed—his description of this sensation corresponding exactly to that experienced during a change of accommodation. But if the same weak concave lens was moved rapidly past the eye, vision was not improved; and Von Græfe therefore thinks that in the latter instance the necessary changes in the refraction of the eye could not be attained in a sufficiently short space of time. If, however, whilst the patient was still looking at a distant object, a strong concave lens (No. 6) was placed before the eye, he could *instantly* see distinctly, and did not experience the above-mentioned sensation of a change of accommodation; moreover, the distant objects appeared at once perfectly distinct, even when this strong concave glass was moved rapidly past the eye.

From these facts Von Græfe thought it probable that, in looking at distant objects, the patient's eye was not accommodated for its far point, but in an opposite direction, for a much nearer, perhaps even its nearest point of distinct vision. In order to ascertain the accuracy of this supposition, he excluded one eye from participation in the act of vision by partially covering it with his hand, and then examined its position during the accommodation of the other eye.

It is a well known fact that there is no exact dependence between the convergence of the optic axes and the accommodation changes of the eye. This may be easily illustrated by the following experiments:

1. If we place moderately strong convex or concave glasses before normal eyes (whose power of accommodation is also good), they will see an object at a few feet distance sharply and distinctly, and there will be no alteration in the position of the optic axes, although a change in the accommodation is necessitated by the application of the convex or concave lenses.

2. If we place a prism, not too strong, with its base outwards before one eye (whilst the eyes are fixed upon an object at a few feet distance), this eye will move inwards in order to see the object sharply and singly, the convergence of the optic axes is consequently altered, whilst the accommodation remains the same. In this way the relative independence of the two functions is clearly proved; but yet this independence is only exceedingly limited. Von Græfe thinks that this apparent independence is entirely a product of the impulse for single vision, which makes itself felt when both eyes are open, and that, owing to this, the natural dependence of the two factors is to a certain degree relaxed. For as soon as the binocular act of vision is annulled, the natural dependence shows itself by the fact, that every change in the accommodation is accompanied by an alteration in the convergence of the optic axes. If, whilst a person accommodates with the one eye alternately for near and distant objects, we partially cover the other eye with our hand, so as to prevent its seeing the object (but yet permitting us to watch its position accurately), we find that,

whenever the state of refraction increases (accommodation for near objects), the covered eye always moves inwards when the state of refraction decreases.

Von Graefe therefore took the position of the covered eye as an index for the change in the state of the accommodation in the other eye, in order to ascertain the exact nature of myopia in distans. "'For if the eye, in looking at a distant object, was not accommodated for its far point, but for a contrary direction, the other covered eye ought, when the object is gradually moved away beyond the far point, to deviate slightly inwards; and this did in reality happen, and, in fact, just at the moment when the sudden indistinctness of vision occurred. Besides this, it also appeared that, if the patient looked first at a distant object with the naked eye, and a weak concave lens (No. 30,) was then placed before it, the semi-covered eye deviated slightly outwards—a proof that the state of refraction was diminished. This occurred simultaneously with the sensible change in the 'tension of his eyes' which the patient experienced. If, on the other hand, strong concave glasses (6) were held before the eye, in which case distinct vision instantaneously occurred, not the slightest deviation in the position of the other eye appeared, from which I concluded that now, also, no alteration in the condition of accommodation of the eye had occurred, and that consequently the eye was previously, in looking at distant objects, in almost its maximum state of refraction, or, at all events, more adjusted for its near than for its far point.

"'It would therefore appear that, in myopia in distans, the comparatively small circles of dispersion which distant objects would produce as long as adaptation for the far point was preserved, are in some way incompatible with the act of vision, so that under their influence an impulse for the induction of an opposite condition of accommodation arises.'"*

Persons suffering from this peculiar form of myopia in distans are enabled to see most accurately at a distance with very weak concave glasses. Their far point is at a normal distance from the eye, their vision is perfectly good, only when accommodating for their far point a sudden spasmodic increase in the refraction of their eye occurs, and the object appears dim and indistinct.

This affection is undoubtedly very rare. Donders thinks that myopia in distans is often due to abnormal dilatation of the pupil. When speaking of spasm of the ciliary muscle, I shall hereafter show that there may be apparent myopia in distans, the patient seeing better at a distance with a slightly concave lens, and yet his eye be hypermetropic, and not myopic; for upon the instillation of a strong solution of atropine, and consequent paralysis of the ciliary muscle, he requires convex, and not concave glasses for distant vision.

The degree of myopia is easily determined according to Donder's method. If, for instance, a myopic person can read No. 1 of Jager up to a distance of 10″, his far point lies at 10″, and his myopia = 1–10; for with a concave glass of 10″ focus he would be able to unite parallel rays upon the retina; for does not this glass render parallel rays so divergent as if they came from a distance of 10″ before the eye? We at the same time obtain a clue as to what glasses the patient will require for distant objects.

But although theoretically a concave glass of 10″ focus should be the proper one, we find in practice that it would be too strong. This is due to the convergence of the optic axes, for this convergence prevents the eye from accommodating itself for its far point, the latter is only attainable when we look at distant objects with parallel optic axes. We should therefore find that our patient would perhaps require concave glasses of 12″ or 13″ focus.

Nothing is easier than to determine whether or not the glass thus found accurately suits the patient's sight. We have but to let him look through the proper concave glass at No. 20 of Jager's test-type, placed at a distance of about 20′, so that the rays would impinge in a parallel direction upon the eye. In our supposed case, the spectacles would be No. 10 concave. With these he can read Nos. 19 and 20 fluently. We now alternately place very weak concave or convex glasses before the spectacles, and try their effect. If slightly concave glasses improve vision, the original glasses (No. 10) are too weak; if, on the other hand, convex glasses improve it, they are too strong. If neither the one nor the other render any improvement, the spectables suit exactly. Let us illustrate this by a few simple examples:

A comes to us with a myopia = 1–10, we give him concave glasses of 10″ focus,* and tell him to read No. 20 at 20′ distance. He can do so, and even see No. 19, but somewhat indistinctly. We place No. 60 convex before the spectacles, and find that this renders the letters clearer, convex

* Archiv., ii., 1, 167.

* In Germany, and at the Royal London Ophthalmic Hospital, Moorfields, the concave glasses are numbered according to their focal length (which is negative.)

50 improves vision still more (with it he can read No. 18), but convex 40 renders it more indistinct. The original glass (concave 10) is, consequently, somewhat too strong, and, in order to suit the patient's sight exactly, we must deduct 50 from it. His myopia is, therefore, 1–10—1–50; consequently, =1–12½. We give the patient concave 13, and find that neither concave or convex glasses render any improvement. He is therefore accurately suited.†

B also appears to have a myopia =1–10. He is tried in the same way with concave 10. In his case we, however, find that convex glasses render his vision more indistinct, but that concave glasses improve it—concave 50 most of all—we therefore have to add this to the original glass (No. 10), which was too weak. His myopia therefore =1–10 +1–50=8⅓. We try concave 9, and find that vision is not improved by any weak convex or concave glass.

Another patient desires to have spectacles which will enable him to see objects at a distance of 2′ (for instance, the music whilst playing the piano). For distant objects he requires concave 12. How are we to find the right glasses for objects at 2′? Simply thus: If his myopia equals about 1–12, the glasses to see with at 24″ will be about —1–12+1–24=—1–24. Hence concave 24 will suit him for seeing at 2′.

In the same way we can find what glasses are required for reading at 1′ distance in a myopia = 1–6; —1–6+1–12=—1–12. Concave 13 would be required for this purpose. We shall, however, find that the patient requires a somewhat weaker glass, because the convergence of the optic axes to a point 12″ distant already necessitates an accommodation for a nearer point.

As the amount of the range of accommodation (A) which the patient possesses very materially influences our choice of spectacles, and the question whether or not they are to be used for near objects, we must, in the next place, shortly consider how the range of accommodation is to be tested in a myopic eye. We may do this in two ways:

1. We let the patient read No. 1 of the test-type, and, by alternately moving it nearer and further from the eye, we ascertain his near (p) and far (r) point. Let us suppose that p=3″, and r=6″. His range of accommodation is found by the formula—

A=1–p—1–r, therefore A=1–3—1–6=1–6

† The distance between the glass and the eye (about half an inch) we have not calculated, in order to render the formula as simple as possible.

2. Donders has lately, however, preferred the following plan:—He gives the patient those glasses which neutralize the myopia, and enable him to see distant objects distinctly (by means of which he can therefore unite parallel rays upon the retina). Let us again suppose that No. 10 (concave) is the weakest glass with which he can read No. 19 or 18 quite distinctly and sharply at 20′ distance. His far point will, therefore, with concave 10, lie at infinite distance (∞). With the same glass we now try how near he can read No. 1 comfortably and with ease; let us suppose that this be at 5″, his A therefore =1–5, for r= ∞, p=5, A=1–5—1–∞=1–5.

The great advantage of this method is, that the patient really accommodates for his far point, which is not the case in the former plan; for owing to the amount of convergence at 6″, the patient cannot relax his accommodation sufficiently to accommodate for his far point.*

Short-sighted persons often inquire whether they may wear spectacles. Now, all practitioners are, I think, agreed as to the advisability of allowing myopic persons spectacles, for the purpose of seeing distant objects. For we thus change their eyes into normal ones, and enable them to unite parallel rays upon the retina. We should, however, prescribe the weakest glass with which the patient can see clearly and distinctly at a distance, so that he may only make use of a minimum of his power of accommodation, and not have to strain it unduly when observing near objects. For we must remember that he will but seldom have to look for any length of time at a distance, but will alternately observe near and distant objects. One moment looking at something on the opposite side of the street, the next into a shop window, or at some object near at hand. Now, if the glasses are too strong, he is already obliged to use more than a minimum of his power of accommodation when observing distant objects, and will consequently have to make use of a still greater amount, (perhaps almost the whole,) when looking at things but a short distance from him. His myopia will therefore soon increase.

There can also be no harm in allowing short-sighted persons glasses for the purpose of seeing things at a few feet distance (*e. g.*, playing the piano, &c.)

The patient may, however, also desire spectacles for reading, writing, &c. Now, Donders thinks that although it is advisable to give myopic persons at first weaker glasses for reading than for

* We have already (p. 21) explained the method of testing the range of accommodation with a strong convex lens.

distant objects, we should at a later period, if their range of accommodation be good, give them (even for reading) spectacles which completely neutralize their myopia.

It is still, however, a much debated question whether short-sighted persons should be allowed glasses for reading, writing, &c. DONDERS strongly recommends it (except in exceptional cases) for the following reasons:

1. Because strong convergence of the optic axes is necessarily paired with tension of the accommodation. The latter is an associated action, not arising from the mechanism of the convergence, but existing within the eye itself, and may consequently easily lead to an increase of the myopia. Besides this, the pressure of the muscles upon the eyeball appears to be greater when the optic axes are convergent than when they are parallel, and this increase of pressure cannot but tend to give rise to the development of posterior staphyloma.

2. On account of the habit which short-sighted persons have of bending their heads forward during reading or writing. This must cause an increased flow of blood to the eye and an increased tension within the eye itself. Owing to this the development of sclerotico-choroiditis posterior, effusions of blood, and detachment of the retina, which are so apt to occur in short-sighted persons, are undoubtedly greatly promoted. For this reason we should always tell these patients to read with their head well thrown back, and to write at a sloping desk.

But it may, on the other hand, be urged that it is just in looking at near objects that myopic persons have an advantage, for they can see them remarkably distinctly. And the great danger is, that after reading for a short time with spectacles, the patient on getting somewhat fatigued will, instead of laying the book aside, approach it nearer to the eye, in order to gain greater retinal images, and thus strain and tax his power of accommodation too much. If we, for instance, give a patient, whose far point lies at 8″, a pair of spectacles which enable him to read at 12″, he will, if not very careful, after a short time almost insensibly bring the book nearer to his eyes, and thus have to make use of a greater amount of accommodation. If he does this frequently, he will soon increase his myopia. The greater the range of accommodation the less harm will spectacles do, and *vice versa*.

Spectacles may also be used for near objects in those cases of myopia in which asthenopia (depending upon insufficiency of the internal recti muscles) shows itself as soon as the patient has read or worked at near objects for a short time.

Whilst these forms of myopia may be furnished with spectacles for near objects, it is very dangerous to permit their use in patients whose range of accommodation is very limited, and who, moreover, suffer perhaps from such an amount of amblyopia (generally depending upon sclerotico-choroiditis posterior) that they cannot read No. 4 or 5 of JAGER even with the most accurately chosen glasses. Such patients will bring the object very close to the eye, in order to obtain large retinal images, the accommodation will be greatly strained, the intra-ocular tension be increased, and great mischief will be sure to ensue. If there is much amblyopia, spectacles should not be permitted at all for near objects."